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Application of Combustion Modifications to Industrial Combustion Equipment (Data Supplement B)

KVB, Inc, Tustin, CA

Prepared for

Industrial Environmental Research Lab, Research Triangle Park, NC

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Industrial Environmental Research
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Research Triangle Park NC 27711

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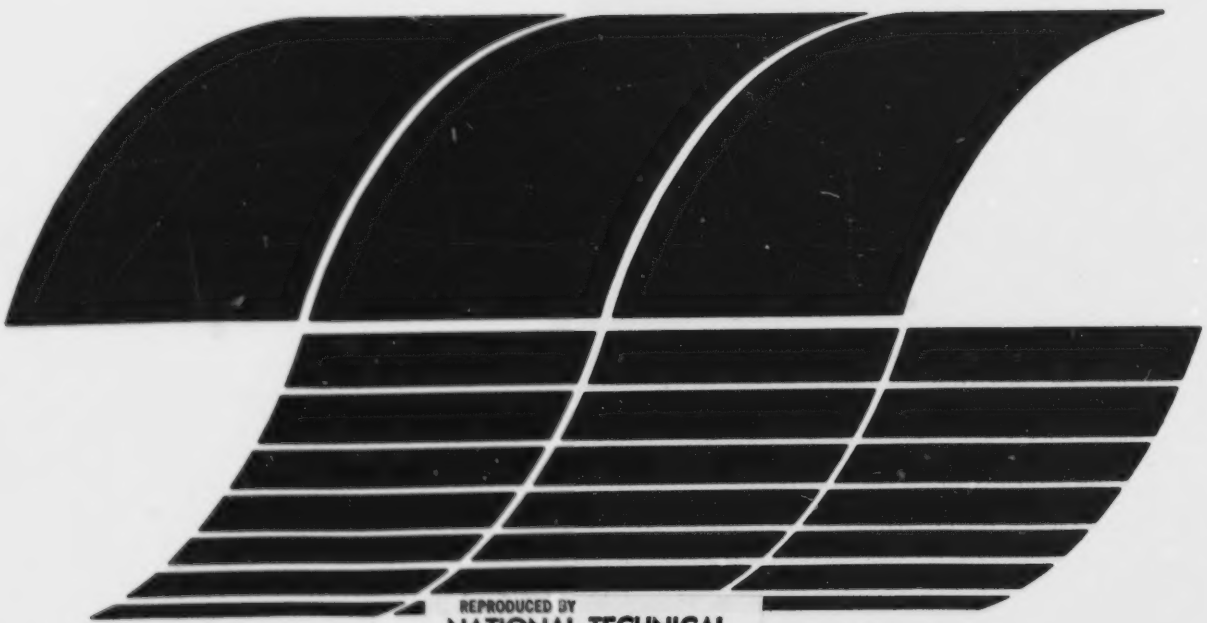
Application of Combustion Modifications to Industrial Combustion Equipment
(Data Supplement B)

Interagency Energy/Environment R&D Program Report



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16. ABSTRACT The supplement provides raw data from a study of the effects of combustion modifications on air pollutant emissions from a variety of industrial combustion equipment. Tested were 22 units, including refinery process heaters; clay and cement kilns; steel and aluminum furnaces; boilers burning black liquor, woodbark, and CO gas; internal combustion engines; and gas turbine combined cycles. Process variables, fuel types, excess air reduction, burner adjustments, and staged combustion were evaluated primarily for their effect on NOx emissions. Emissions of NOx, SOx, CO, and HC were measured on all units. Emissions of particulate mass and size, trace species, and organics were measured on selected units. This data supplement is intended for researchers who wish to perform their own detailed calculations.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group	
Air Pollution	Chemical Analysis	Air Pollution Control	13B	07D
Combustion	Industrial Processes	Stationary Sources	21B	13H
Boilers	Gas Turbine Engines	Combustion Modification	13A	21E
Furnaces	Reciprocating Engines	Particulate		
Nitrogen Oxides		Excess Air	07B	21G
Dust	Organic Compounds	Staged Combustion	11G	07C
Fossil Fuels	Inorganic Compounds		21D	
Particle Size			14B	

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K.T. Fisher, H.J. Buening, W.A. Carter,
P.K. Engel, S.C. Hunter, and R.J. Tidona

KVB, Inc.
17332 Irvine Boulevard
Tustin, California 92680

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Program Element No. EHE624A

EPA Project Officer: Robert E. Hall

Industrial Environmental Research Laboratory
Office of Energy, Minerals, and Industry
Research Triangle Park, NC 27711

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, DC 20460

Limitations On Application Of Data Reported

The data cited in this report are test results for measured pollutant emissions from a wide variety of industrial combustion equipment types. Only a limited number of each equipment type could be tested. Therefore, these emission levels are not suitable for use in estimating mean emissions from industrial combustion equipment classes and should not be used alone in compiling area-wide emission inventories. Also, they are not suitable for predicting emissions from any one process or as regulatory limits or emission standards. Use of these emissions as emission standards may place a large proportion of the industrial combustion device population in noncompliance. The data can however be of use in supplementing other data used for these purposes. The purpose of this test program was to investigate the feasibility of combustion modifications for emissions control, not to develop a comprehensive emissions data base.

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Data Supplement A contains the following location numbers:

1	Ceramic Tunnel Kiln	1
2	Internal Combustion Engine	10
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FOREWORD

The purpose of this Data Supplement, which is presented in two volumes, is to document data in greater detail than was practical in the final report for this contract. It is intended to provide the necessary details to other researchers who are interested in performing their own analysis.

Readers are referred to the contract final report for information as to objectives, selection of units, measurement procedures, interpretations and conclusions.[1]

All data presented for gaseous emission concentrations of NO, NO_x, CO, HC, SO_2 and SO_3 are expressed in parts per million by volume (ppm) on a dry basis corrected to 3 percent O_2 by volume (dry) in the flue gas.

The data are arranged in this volume by Location Number for Locations 1 through 16. A location is defined as one company or plant in which one or more units were tested. Each unit tested at a location is identified by a unit number. The contract final report refers to the test number when data are discussed. The test number is of the form xx/yy-zz, where xx = location number, yy = unit number, and zz = test number on that unit. For sites where only one unit was tested the /yy unit number is deleted.

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[1]Hunter, S. C., et al., "Application of Combustion Modifications to Industrial Combustion Equipment," EPA 600/7-79-105a, January 1979.

For each unit tested, the data supplement contains the following information:

1. Equipment Design Data

   Design data tabulations include: unit description, installation date, process capacity, burner description, fuels burned, combustion air temperature and other data pertinent to each unit.

2. Mobile Laboratory Data (Emission Measurements)

   Emission measurements tabulated for each test include test number, test load, combustion conditions (excess O_2, CO_2), gaseous emissions (NO_x, NO, CO, HC, SO_x and SO_2 all at 3% O_2, dry), total particulates and solid (filterable) particulates, thermal efficiency, Bacharach smoke spot number, and plume opacity.

3. Operating Data

   Data pertinent to the process is tabulated for each test.

4. Fuel Analyses

   Analyses of test fuels are included as reported for fuel samples collected during tests.

5. Particulates Measurement Data

   Particulates data includes measurements of total and solid particulates by EPA Method 5.

6. Cascade Impactor Data

   Impactor data include impactor flow conditions, stage collection weights, and calculated aerodynamic particle size for each stage.

   One impactor used was a Brink Model B (BMS-11) with the following stage dimensions:

Jet No.	Jet Dia., in.	Spacing of Jet Opening, in.
1	0.249	0.747
2	0.1775	0.533
3	0.1396	0.419
4	0.0946	0.282
5	0.0731	0.220

The second impactor used was an Anderson 2000 Mark III with the following stage dimensions:

Stage No.	Jet Diameter, cm
1	0.1638
2	0.1253
3	0.0948
4	0.0759
5	0.0567
6	0.0359
7	0.0261
8	0.0251

7. Opacity Data

Plume opacity was observed by EPA Method 9.

8. Stack Traverse Data

Stack traverses are made with a pitot tube.

9. Trace Species and Organics Sample Data

Sample acquisition logs and results of sample analyses by atomic absorption, spark source mass spectrometry, wet chemistry, gas chromatography, and gas chromatography/mass spectrometry are included.

Dash marks entered on the data forms indicate that data were not available.

INSTRUMENTATION

The emission measurements were made with instrumentation contained in a 2.5 by 9 meter (8 by 27 ft) laboratory trailer. The gaseous emission measurements were made with analyzers located in the measurement console in the trailer. The particulate concentration, particulate size, sulfur oxides, and trace species concentration measurements were made with instrumentation prepared in the wet chemistry area of the laboratory and taken to the sample port. The weighing and titration were done in or near the laboratory.

The emission measurement instrumentation used for the program was that shown in Table 1. The operation of the instrumentation is discussed in detail in the contract final report.

TABLE 1. EMISSION MEASUREMENT INSTRUMENTATION

Emission	Symbol	Measurement Method	Equipment Mfgr & Model
Nitric oxide	NO	Chemiluminescent*	Thermo Electron, 10A
Oxides of nitrogen	NO_x	Chemiluminescent*	Thermo Electron, 10A
Carbon monoxide	CO	Spectrometer*	Beckman, 864
Carbon dioxide	CO_2	Spectrometer*	Beckman, 865
Oxygen	O_2	Polarographic*	Teledyne, 326A
Hydrocarbons	HC	Flame ionization*	Beckman, 402
Sulfur dioxide	SO_2	Photometric*	Dupont 400
Sulfur dioxide and trioxide	SO_2 SO_3	Absorption/ titration	KVB Equipment Co.
Total particulate matter	PM	EPA Std. Method 5	Joy Mfg. Co.
Particulate size	--	Cascade impactor	Monsanto-Brink, B(BMS-11) Anderson 2000, Mark III
Smoke spot	--	Reflection	Research Appliance Co.
Opacity	--	EPA Std. Method 9	--
Trace Species and Organics	TS&O	EPA SASS Train	Acurex/Aerotherm SASS

*Precision, ± 1% of Full Scale

GLOSSARY OF SYMBOLS USED ON DATA FORMS

Burner Type

Air	Air Atomizer
ChGrt	Chain Grate
Pulv.	Pulverizer
Ring	Natural Gas Ring
SpStk	Spreader Stoker
Spud	Natural Gas Gun
Steam	Steam Atomizer

Test Fuel

Coal	Coal
NG	Natural Gas
Ref.Gas	Refinery Gas
NG/#6	Mixture, NG and #6
#2	No. 2 Grade Fuel Oil
#5	No. 5 Grade Fuel Oil
#6	No. 6 Grade Fuel Oil
PS300	Pacific Standard Fuel Oil No. 300

Test Type

Air Reg	Air Register Adjustment
Atom Press	Burner Atomizing Pressure Adjustment
BOOS	Burners Out Of Service
Base	Baseline
BrTune	Boiler Tuneup
CombCyc	Combined Cycle
Damper	Air Damper Adjustment
HiAir	High Excess Air
HiLoad	High Load
LowAir	Low Excess Air
LowLoad	Low Load
LowNOx	Low NOx Condition
NrmlAir	Normal Excess Air
OFA	Overfire Air
SCA	Staged Combustion Air
SnglCyc	Single Cycle
SteamInjec	Steam Injection
VPH	Variable Combustion Air Temperature
Viscosity	Fuel Oil Viscosity

CONVERSION FACTORS

SI Units to Metric or English Units

To Obtain	From	Multiply By
g/Mcal	ng/J	0.004186
10^6 Btu	GJ	0.948
Btu	gm cal	3.9685×10^{-3}
lb/10^6 Btu	ng/J	0.00233
ft	m	3.281
in.	cm	0.3937
ft^2	m^2	10.764
ft^3	m^3	35.314
lb	kg	2.205
Fahrenheit	Celsius	$t_F = 9/5(t_c) + 32$
Fahrenheit	Kelvin	$t_F = 1.8t_K - 460$
psig	Pa	$P_{psig} = (P_{pa})(1.450 \times 10^{-4}) - 14.7$
psia	Pa	$P_{psia} = (P_{pa})(1.450 \times 10^{-4})$
iwg (39.2 °F)	Pa	$P_{iwg} = (P_{pa})(4.014 \times 10^{-3})$
10^6 Btu/hr	MW	3.413
GJ/hr	MW	3.60

To Obtain ppm at 3% O_2 of	Multiply* Concentration in ng/J by
Natural Gas Fuel	
CO	3.23
HC	5.65
NO or NO_x	1.96
SO_2 or SO_x	1.41
Oil Fuel	
CO	2.93
HC	5.13
NO or NO_x	1.78
SO_2 or SO_x	1.28
Coal Fuel	
CO	2.69
HC	4.69
NO or NO_x	1.64
SO_2 or SO_x	1.18

*These conversions depend on fuel composition.
The values given are for typical fuels.

English and Metric Units to SI Units

To Obtain	From	Multiply By
ng/J	$lb/10^6$ Btu	430
ng/J	g/Mcal	239
GJ	10^6 Btu	1.055
m	ft	0.3048
cm	in.	2.54
m^2	ft^2	0.0929
m^3	ft^3	0.02832
kg	lb	0.4536
Celsius	Fahrenheit	$t_c = 5/9\ (t_F - 32)$
Kelvin	Fahrenheit	$t_K = 5/9\ (t_F - 32) + 273$
Pa	psig	$P_{pa} = (P_{psig} + 14.7)(6.895 \times 10^3)$
Pa	psia	$P_{pa} = (P_{psia})(6.895 \times 10^3)$
Pa	iwg (39.2 °F)	$P_{pa} = (P_{iwg})(249.1)$
MW	10^6 Btu/hr	0.293
MW	GJ/hr	0.278

To Obtain ng/J of	Multiply* Concentration in ppm @ 3% O_2 by
Natural Gas Fuel	
CO	0.310
HC	0.177
NO or NO_x (as NO_2)	0.510
SO_2 or SO_x	0.709
Oil Fuel	
CO	0.341
HC	0.195
NO or NO_x (as NO_2)	0.561
SO_2 or SO_x	0.780
Coal Fuel	
CO	0.372
HC	0.213
NO or NO_x (as NO_2)	0.611
SO_2 or SO_x	0.850

*These conversions depend on fuel composition.
The values given are for typical fuels.

WOOD-BARK BOILER

Location No. 10 Unit No. 1

Unit Description Wood-Bark Boiler
Wood-Bark & Nat Gas 90 700kg/h (200,000lb/h)
Wood-Bark Only 68 000kg/h (150,000lb/h)
Wood-Bark On Overfed Traveling Grate Stoker

Installation Date

Heater Rating

Burner Description B&W 4 Slotted Throat Multi Spud Gas Burner

Test Fuel Combinations Wood-Bark & Nat. Gas

Fuel Temp. at Burner (°F) Ambient

Primary Air Temp. (°F) Undergrate 274°C 525°F)

Comments:

MOBILE LABORATORY DATA Test No. _____

Test No. 10/1-1 Date 8-17-76 Location 10, Engr. K.

Unit No. 1 Fuel N.G. & Coal Capacity 200 000 #/Hr

Unit Type B&W Stoker Burner Type Grate & Gas Spuds

		①			
1. Test No.	10/1-1	10/1-1			
2. Date	8-17	8-17-76			
3. Time	1545	1550			
4. Load #/Hr. x10³	150-165	150-165			
5. Process Rate					
6. Flue Diam. or Size, ft					
7. Probe Position 8" in ①	② I	① O			
8. Oxygen (%)	9.3	10.25			
9. NOx (hot) read/3% O_2 (ppm)	—	107	179		
10. NO (hot) read/3% O_2 (ppm)	—	90	151		
11. NO_2 (hot) read/3% O_2 (ppm)	—	17	28		
12. NO (cold) read/3% O_2 (ppm)	162	172	115	193	
13. Carbon Dioxide (%)	9.9	8.0			
14. Carbon Monoxide (ppm) uncor/cor	1040	1620	1190	1998	
15. Hydrocarbon (ppm) uncor/cor	—	—	25	42	
16. Sulfur Dioxide (ppm) uncor/cor	—	—	0	0	
17. Smoke Spot (Bacharach)	—		—		
18. Atmos. Temp. (°F/°C)	91		91		
19. Dew Point Temp. (°F/°C)	80		80		
20. Atmos. Pressure (in. Hg)	29.84		29.84		
21. Relative Humidity (%)	62		62		
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

⑥ After Air Heater O - Hot Side

② → Before Air Heater I Cold Side

Baseline ↑ Baseline →

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 10/1-1 Date 8-18-76 Location 10 Engr. HANS

Unit No. 1 Fuel N.G. + Wood Capacity 200,000 lb/hr

Unit Type B+W SToker Burner Type Grate + Goo Spuds

		(2)		(3)	(4)
1. Test No.	10/1-1	10/1-1	10/1-1	10/1-1	10/1-1
2. Date	8-18-76	8-18-76	8-18-76	8-18-76	8-18-76
3. Time	0910	0915	1115	1121	1530
4. Load lb/hr $\times 10^3$	175-225	175-225	175-200	175-200	170-190
5. Process Rate					
6. Flue Diam. or Size, ft					
7. Probe Position	①	②	①	②	①
8. Oxygen (%)	6.5	7.5	9.0	9.0	9.5
9. NOx (hot) read/3% O_2 (ppm)	87 / 108	—	105 / 157	—	107 / 167
10. NO (hot) read/3% O_2 (ppm)	82 / 102	—	104 / 156	—	100 / 157
11. NO_2 (hot) read/3% O_2 (ppm)	5 / 6	—	1 / 1	—	7 / 11
12. NO (cold) read/3% O_2 (ppm)	105 / 130	95 / 127	185 / 187	117 / 175	125 / 196
13. Carbon Dioxide (%)	9.2	8.7	9.2	7.4	7.7
14. Carbon Monoxide (ppm) uncor/cor	860 / 1068	280 / 373	250 / 375	160 / 240	240 / 376
15. Hydrocarbon (ppm)	75 / 93	—	0 / 0	—	0 /
16. Sulfur Dioxide (ppm)	0 / 0	—	4 / 6	—	4 / 6
17. Smoke Spot (Bacharach)	—	—	—	—	—
18. Atmos. Temp. (°F/°C)	80	80	85	85	94
19. Dew Point Temp. (°F/°C)	76	76	76	76	77
20. Atmos. Pressure (in. Hg)	29.82	29.82	29.80	29.80	29.70
21. Relative Humidity (%)	84	84	68	68	47
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

Data Sheet 6002-2

Baseline

Particulate Test Baseline

Brick Baseline

②

MOBILE LABORATORY DATA Test No. _____

Test No. 10/1-1 Date 8-18-76 Location 10 Engr. HANS

Unit No. 1 Fuel N.G. & Wood Capacity 200,000 lb/hr

Unit Type B+W Stoker Burner Type Grate & Gas Spuds

④

1. Test No.	10/1-1									
2. Date	8-18-76									
3. Time	1540									
4. Load	170-190									
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	②									
8. Oxygen (%)	8.4									
9. NOx (hot) read/3% O_2 (ppm)	—									
10. NO (hot) read/3% O_2 (ppm)	—									
11. NO_2 (hot) read/3% O_2 (ppm)	—									
12. NO (cold) read/3% O_2 (ppm)	105	150								
13. Carbon Dioxide (%)	8.0									
14. Carbon Monoxide (ppm) uncor/cor	210	300								
15. Hydrocarbon (ppm) uncor/cor	—									
16. Sulfur Dioxide (ppm) uncor/cor	—									
17. Smoke Spot (Bacharach)	—									
18. Atmos. Temp. (°F/°C)	94									
19. Dew Point Temp. (°F/°C)	77									
20. Atmos. Pressure (in. Hg)	29.70									
21. Relative Humidity (%)	47									
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

Brink Gasoline

MOBILE LABORATORY DATA

Test No. _____

Test No. 10/1-2 Date 8-19-76 Location 10 Engr. HANS

Unit No. 1 Fuel N.G. + Wood Capacity 200,000 lb/hr

Unit Type B + W Stoker Burner Type Grate + Gas Spuds

			(5)				(6)			
1. Test No.	10/1-2		10/1-2		10/1-2		10/1-2		10/1-2	
2. Date	8-19-76		8-19-76		8-19-76		8-19-76		8-19-76	
3. Time	1300		1307		1445		1500		1540	
4. Load	150-175		150-175		100		100		105	
5. Process Rate										
6. Flue Diam. or Size, ft	17'6" x 15'1"									
7. Probe Position	①		②		①		②		①	
8. Oxygen (%)	10.25		9.5		13.25		13.00		1400	
9. NOx (hot) read/3% O_2 (ppm)	87	146	—		64	149	—		93	239
10. NO (hot) read/3% O_2 (ppm)	82	137	—		60	139	—		90	231
11. NO_2 (hot) read/3% O_2 (ppm)	5	8	—		4	10	—		3	8
12. NO (cold) read/3% O_2 (ppm)	116	194	120	188	83	193	105	236	97	249
13. Carbon Dioxide (%)	7.8		8.0		5.3		5.9		4.4	
14. Carbon Monoxide (ppm) uncor/cor	1110	1859	890	1393	[illegible] 2000	—	[illegible] 2000	—	[illegible] 2000	—
15. Hydrocarbon (ppm)	14	23	—		80 250	186 580	—		50 250	129 643
16. Sulfur Dioxide (ppm)	0	0	—		100	232	—		90	231
17. Smoke Spot (Bacharach)	—		—		—		—			
18. Atmos. Temp. (°F/°C)	89		89		91		91		92	
19. Dew Point Temp. (°F/°C)	75		75		76		76		76	
20. Atmos. Pressure (in. Hg)	29.79		29.79		29.76		29.76		29.76	
21. Relative Humidity (%)	53		53		50		50		49	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

COULD BE PLUGGED VAC AT 16

Baseline

A.H. 100% Bypassed

A.H. 50% Bypassed

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 10/1-2 Date 8-19-76 Location 10 Engr. H. BUENING

Unit No. 1 Fuel N.G. & BARK Capacity 200,000 LB/HR

Unit Type B & W STOKER Burner Type GRATE & GAS SPUDS

	(1)		(2)					
1. Test No.	10/1-2		10/1-2		10/1-2			
2. Date	8-19-76		8-19-76		8-19-76			
3. Time	1555		1635		1655			
4. Load	105		50-150		50-150			
5. Process Rate								
6. Flue Diam. or Size, ft								
7. Probe Position	(2)		(1)		(2)			
8. Oxygen (%)	14.25		13.5		13.25			
9. NOx (hot) read/3% O_2 (ppm)	—		85	204	—			
10. NO (hot) read/3% O_2 (ppm)	—		80	192	—			
11. NO_2 (hot) read/3% O_2 (ppm)	—		5	12	—			
12. NO (cold) read/3% O_2 (ppm)	75	200	92	221	92	214		
13. Carbon Dioxide (%)	4.1		4.5		5.5			
14. Carbon Monoxide (ppm) uncor/cor	EXCESS 2000	/	EXCESS 2000	/	EXCESS 2000	/		
15. Hydrocarbon (ppm)	—		25 150	60 360	—			
16. Sulfur Dioxide (ppm)	—		50	120	—			
17. Smoke Spot (Bacharach)	—		—		—			
18. Atmos. Temp. (°F/°C)	92		92		91			
19. Dew Point Temp. (°F/°C)	76		76		75			
20. Atmos. Pressure (in. Hg)	29.76		29.76		29.76			
21. Relative Humidity (%)	49		49		48			
22.								
23.								
24.								
25.								
26.			SWINGING WIDELY					
27.								
28.								
29.								
30.								

A.H. 50% Bypassed Tempering air closed

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 10/1-2 Date 8-23-76 Location 10 Engr. Vc.

Unit No. 1 Fuel N.G. & Coal Capacity 200,000 #/Hr.

Unit Type B&W Stoker Burner Type Grate & Gas Spuds

	(9)				(10)		(11)	
1. Test No.	10/1-2							
2. Date	8-23-76							
3. Time	1005				1045		11:32	
4. Load	110-140				108-160		140-200	
5. Process Rate								
6. Flue Diam. or Size, ft								
7. Probe Position	1		2		1		1	
8. Oxygen (%)	12.5		11.0		9.75		8.0	
9. NOx (hot) read/3% O_2 (ppm)	85	180	—	—	95	152	105	145
10. NO (hot) read/3% O_2 (ppm)	75	159	—	—	95	152	95	132
11. NO_2 (hot) read/3% O_2 (ppm)	10	21	—	—	0	--	10	13
12. NO (cold) read/3% O_2 (ppm)	85	180	100	180	110	176	137	190
13. Carbon Dioxide (%)	5.9		8		9		9.9	
14. Carbon Monoxide (ppm) uncor/cor	780 / 1248	1652 / 2626	420 / 1000	846 / 1800	620 / 1001	992 / 1600	~340	544
15. Hydrocarbon (ppm)	20	42	—	—	20	32	10	14
16. Sulfur Dioxide (ppm)	0	-	—	—	40	64	~20	28
17. Smoke Spot (Bacharach)	—		—		—		—	
18. Atmos. Temp. (°F/°C)	81		→		83		85	
19. Dew Point Temp. (°F/°C)	75		→		70		70	
20. Atmos. Pressure (in. Hg)	29.99		→		29.99		29.98	
21. Relative Humidity (%)	76		→		55		48	
22.								
23.								
24.								
25.								
26.								
27.								
28.								
29.								
30.								

Data Sheet 6002-2

Baseline

Up 1 Boss

Up 2 Boss

MOBILE LABORATORY DATA

Test No. _____

Test No. 10/1-2 Date 8-23-76 Location 10 Engr. [illegible]

Unit No. 1 Fuel UG & Wood Capacity 200,000 #/Hr

Unit Type B & W Stoker Burner Type Grate & Gas Spuds

			(12)			(13)			
1. Test No.	10/1-2		→			→			
2. Date	8-23-76		→			→			
3. Time	1148		1300		1320		1400		
4. Load			130-160				165-180		
5. Process Rate									
6. Flue Diam. or Size, ft									
7. Probe Position	2		1		2		1		2
8. Oxygen (%)	11.25		10.25		11.75		8.5		10.00
9. NOx (hot) read/3% O_2 (ppm)	—		90	151	—		95	137	—
10. NO (hot) read/3% O_2 (ppm)	—		85	142	—		90	130	—
11. NO_2 (hot) read/3% O_2 (ppm)	—		5	9	—		5	7	—
12. NO (cold) read/3% O_2 (ppm)	100	185	115	193	105	204	115	166	110	176
13. Carbon Dioxide (%)	8		7.4		7.1		9.2		7.1	
14. Carbon Monoxide (ppm) uncor/cor	470 / 620	868 / 1145	620 / 1000	1038 / 1674	220 / 400	428 / 778	~ / 400	576	~ / 340	544
15. Hydrocarbon (ppm)	—		~ / 30	50	—		10	14	—	
16. Sulfur Dioxide (ppm)	—		20	33	—		20	29	—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	85		88		→		89		→	
19. Dew Point Temp. (°F/°C)	70		74		→		75		→	
20. Atmos. Pressure (in. Hg)	29.98		29.97		→		29.95		→	
21. Relative Humidity (%)	48		52		→		52		→	
22.									
23.									
24.									
25.									
26.									
27.									
28.									
29.									
30.									

Nº 3 Boos

Nº 4 Boos

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 10/1-2 Date 8-23-76 Location ID Engr. H.B.

Unit No. 1 Fuel NB. & WOOD Capacity 200,000 #/HR

Unit Type B & W STOKER Burner Type GRATE & GAS SPUDS

(14)

1. Test No.	10/1-2		—								→	
2. Date	8-23-76		—								→	
3. Time	1530		1540									
4. Load	175-205											
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	1		2									
8. Oxygen (%)	7.4		7.8									
9. NOx (hot) read/3% O_2 (ppm)	150	199	—									
10. NO (hot) read/3% O_2 (ppm)	140	185	—									
11. NO_2 (hot) read/3% O_2 (ppm)	10	14	—									
12. NO (cold) read/3% O_2 (ppm)	170	225	165	225								
13. Carbon Dioxide (%)	10.3		10.5									
14. Carbon Monoxide (ppm) uncor/cor	520	689	500	682								
15. Hydrocarbon (ppm)	8	11	—									
16. Sulfur Dioxide (ppm)	10	13	—									
17. Smoke Spot (Bacharach)	—		—									
18. Atmos. Temp. (°F/°C)	93		→									
19. Dew Point Temp. (°F/°C)	77		→									
20. Atmos. Pressure (in. Hg)	29.95		→									
21. Relative Humidity (%)	49		→									
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

All burners in service, P.F. adjusted.

AUG 24 1976

MOBILE LABORATORY DATA Test No. _____

Test No. 10/1-2 Date 8-24-76 Location 10 Engr. Ho.

Unit No. 1 Fuel NG & Ethanol Capacity 200,000 #/Hr

Unit Type B&W stoker Burner Type Grate & Gas Spuds

	(1)				1		(1')			
1. Test No.	10/1-2		10/1-2		10/1-2		10/1-2			
2. Date	8-24-76		8-24-76		8-24-76		8-24-76			
3. Time	13:35		13:55		1520		1528			
4. Load	200-235				220-250					
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	0		2		1		2			
8. Oxygen (%)	7.0		3.6		4.0		3.6-4.4			
9. NOx (hot) read/3% O_2 (ppm)	160	206	-	-	175	185	—			
10. NO (hot) read/3% O_2 (ppm)	153	197	-	-	170	180	—			
11. NO_2 (hot) read/3% O_2 (ppm)	7	9	-	-	5	5	—			
12. NO (cold) read/3% O_2 (ppm)	195	251	202	209	215	228	200	212		
13. Carbon Dioxide (%)	11.0		12.0		14.4		14.8			
14. Carbon Monoxide (ppm) uncor/cor	430 580	553 746	575	595	600 1200	635 1271	470 800	488 847		
15. Hydrocarbon (ppm)	5	6	-	-	9/40	10/42	—			
16. Sulfur Dioxide (ppm)	21	27	-	-	22	23	—			
17. Smoke Spot (Bacharach)					—		—			
18. Atmos. Temp. (°F/°C)	89		89		92		→			
19. Dew Point Temp. (°F/°C)	74		74		77		→			
20. Atmos. Pressure (in. Hg)	29.93"		29.95"		29.82		29.82			
21. Relative Humidity (%)	50		50		52		→			
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

Particle. Hole around flue

Brick Hole around flue

OPERATING DATA

Location 10

Unit 1

	①	②	③	④
Test No.	10/1-1	10/1-1	10/1-1	10/1-1
Date	8-17-76	8-18-76	8-18-76	8-18-76
Time	16:00	9:15	11:55	15:20
Steam Flow, lb/hr $\times 10^{-3}$	130-165	175-225	175-200	170-190
Steam Outlet Press., psig	840	840	835	835
Steam Outlet Temp., °F	760	815	810	815
Burner Gas Press., psig	1 (MIN. GAS FLOW)	6.9	6.8	7.0
Furnace Draft, in. H_2O	-.8	-.4	-.4	-0.4
Main Undergrate Air Press., in. H_2O	—	—	—	—
Primary Air Press., in. H_2O	—	—	—	—
A.H. Air Outlet Press., in. H_2O	6.0	5.8	6.0	5.8
A.H. Air Inlet Press., in. H_2O	7.7	7.6	7.6	7.7
F.D. Fan Discharge Press., in. H_2O	8.0	8.0	8.0	8.0
Low. Overfire Air Press., in. H_2O	26	26.5	26	26
Up. Overfire Air Press., in. H_2O	27	27.5	27.5	27.5
I.D. Fan Inlet Draft, in. H_2O	8.5	-9.0	8.7	8.8
A.H. Gas Out, in. H_2O	-4.4	-5.2	-4.7	-5.0
Boiler Outlet Draft, in. H_2O	-2.7	-3.5	-3	-3.2
Undergrate Air Flow, percent	40	41	41	40
Wood Steam Flow, percent	45-60	25-50	20-35	25 (60) *
Windbox Air Flow, percent	28	31.5	33	32
Total Air Flow, percent	62	67	67.5	74
Gas Flow to Burners, SCFH	32000	200,000	200,000	2000 (32%) *
Boiler Outlet O_2, percent	AVE. 3.0	3.5-8.4	6.5-9	7.5 (3-10) *
Boiler Outlet Comb., percent	.15	0	0	0-10
Air Heater Air In, °F	110	95	104	106
Air Heater Air Out, °F	580	587	575	578
Boiler Gas Out, °F	708	712	702	709
Attemp. Steam Out, °F	658	710	700	—
Undergrate Air, °F	525	529	519	520
A.H. Gas Out, °F	500	495	485	489
I.D. Fan Gas In, °F	508	500	490	495
Feedwater Temp., °F	290	290	291	291
Wood Feedscrews Load, percent, 1/2/3	52 | 50 | 55	48 | 46 | 53	46 | 45 | 41	47 | 45 | 52
Air Heater Air Inlet Damper Percent Open	100	100	100	100
Tempering Air Damper Percent Open				
Gas Burners In Service	1,2,3-4 BOOS	1,2,3-4 BOOS	1,2,3-4 BOOS	1,2,3 (#4 BOOS)
Register Setting Percent Open 1/2	80 | 80	80 | 80	80 | 80	80 | 80
Register Setting Percent Open 3/4	75 | 10	75 | 0	75 | 0	75 | 0
Comments:	BASELINE	BASELINE	BASELINE, PARTIC.	BASELINE, BRINK

* CYCLED TO PARENTHETICAL VALUE AT 2 PM FOR APPROXIMATELY ½ hr.

OPERATING DATA

Location 10

Unit 1

	(5)	(6)	(7)	(8)
Test No.	10/1-2	10/1-2	10/1-2	10/1-2
Date	8-19-76	8-19-76	8-19-76	8-19-76
Time	13:15	14:45	15:30	16:45
Steam Flow, lb/hr $\times 10^{-3}$	150-175	100	105	50-150
Steam Outlet Press., psig	820	820	820	800-850
Steam Outlet Temp., °F	760	760	680	770
Burner Gas Press., psig	1.0 (MIN. FLOW)	1	2.2	1.5
Furnace Draft, in. H_2O	-.3	-.4	-.4	-.4
Main Undergrate Air Press., in. H_2O	—	—	—	—
Primary Air Press., in. H_2O	—	—	—	—
A.H. Air Outlet Press., in. H_2O	6	1.4 **	7.2	6
A.H. Air Inlet Press., in. H_2O	7.6	1.5	8	7.4
F.D. Fan Discharge Press., in. H_2O	8	9.5	6-12	7.5
Low. Overfire Air Press., in. H_2O	26	26.5	26.5	26.5
Up. Overfire Air Press., in. H_2O	27	27.2	27.5	27
I.D. Fan Inlet Draft, in. H_2O	8.4	-7.8	-9	28
A.H. Gas Out, in. H_2O	4.5	-4.4	-4.5	-4.5
Boiler Outlet Draft, in. H_2O	3.0	2.7	-2.5	-2.5
Undergrate Air Flow, percent	34	41	47	38
Wood Steam Flow, percent	40-60	20	5-28	0-50
Windbox Air Flow, percent	29	12	31	29
Total Air Flow, percent	58	46	72.5	60
Gas Flow to Burners, SCFH	45000	45000	90000	70000
Boiler Outlet O_2, percent	7-10	>10	9->10	9->10
Boiler Outlet Comb., percent	0	0	0	0
Air Heater Air In, °F	108	A.H. COMPLETELY	108	108
Air Heater Air Out, °F	576	BYPASSED	575 ‡	540
Boiler Gas Out, °F	688	621	652	640
Attemp. Steam Out, °F	645	670	675	690
Undergrate Air, °F	530	160 †	275	490
A.H. Gas Out, °F	498	550	500	462
I.D. Fan Gas In, °F	500	550	510	470
Feedwater Temp., °F	291	290	290	290
Wood Feedscrews Load, percent* 1/2/3	45 | 44 | 51	— | — | —	5.5 | 5 | 5.3	4 | 5 | 5.1
Air Heater Air Inlet Damper Percent Open	100	0	50	50
Tempering Air Damper Percent Open	0 *	100	50	0
Gas Burners In Service	1,2,3-4 OOS	1,2,3-4 OOS	1,2,3-4 OOS	1,2,3-4 OOS
Register Setting Percent Open 1/2	80 | 80	100 | 100	100 | 100	100 | 100
3/4	75 | 0	75 | 100	75 | 100	75 | 100
Comments:	BASELINE		AIR HEATER 50% BYPASSED	AIR HEATER 50% BYPASSED

* NORMAL POSITION

** DAMPER LEAKAGE

† ALSO WINDBOX AIR TEMP.

‡ WINDBOX AIR TO GAS BURNER

* COLUMNS (7) AND (8) ARE RPM

OPERATING DATA

Location 10

Unit 1

	(9)	(10)	(11)	(12)
Test No.	10/1-2	10/1-2	10/1-2	10/1-2
Date	8-23-76	8-23-76	8-23-76	8-23-76
Time	10:15	10:50	11:35	13:10
Steam Flow, lb/hr $\times 10^{-3}$	110-140	108-160	140-200	130-160
Steam Outlet Press., psig	820	830	830	830
Steam Outlet Temp., °F	825	750	810	775
Burner Gas Press., psig	2.8	4.5	4.5	4.5
Furnace Draft, in. H_2O	-.5	-.5	-.5	-.5
Main Undergrate Air Press., in. H_2O	—	—	—	—
Primary Air Press., in. H_2O	—	—	—	—
A.H. Air Outlet Press., in. H_2O	6.0	6.2	6.2	6.2
A.H. Air Inlet Press., in. H_2O	7.5	7.7	8.0	8
F.D. Fan Discharge Press., in. H_2O	8.0	8	7.9	8.2
Low. Overfire Air Press., in. H_2O	26	27	26.5	26.5
Up. Overfire Air Press., in. H_2O	28	28	27.5	27.5
I.D. Fan Inlet Draft, in. H_2O	-7.5	-7.8	-8.2	-7.8
A.H. Gas Out, in. H_2O	-4.2	-4.5	-4.8	-4.3
Boiler Outlet Draft, in. H_2O	-3	-2.7	-3.0	-2.7
Undergrate Air Flow, percent	39	39	39	38
Wood Steam Flow, percent	8-35	8-36	25-56	19-37
Windbox Air Flow, percent	28	29	29	29
Total Air Flow, percent	62	61.5	61	61
Gas Flow to Burners, SCFH	117000	117000	115000	112000
Boiler Outlet O_2, percent	8->10	7.6->10	7->10	6->10
Boiler Outlet Comb., percent	0	0	0	0
Air Heater Air In, °F	92	92	95	103
Air Heater Air Out, °F	538	550	568	555
Boiler Gas Out, °F	660	690	680	690
Attemp. Steam Out, °F	695	668	670	668
Undergrate Air, °F	492	505	518	510
A.H. Gas Out, °F	455	467	485	470
I.D. Fan Gas In, °F	450	470	490	470
Feedwater Temp., °F	291	291	290	291
Wood Feedscrews Load, ~~percent~~ RPM 1/2/3	7 7 7	7 7 7	7 7 7	7 7 7
Air Heater Air Inlet Damper Percent Open	100	100	100	100
Tempering Air Damper Percent Open	0	0	0	0
Gas Burners In Service	ALL 4	2,3,4	1,3,4	1,2,4
Register Setting Percent Open 1/2	100 100	0 90	85 15	80 90
3/4	80 100	80 100	80 100	20 100

Comments: NO1 BURNER 005 NO2 BURNER 005 NO3 8005

OPERATING DATA

Location 10

Unit 1

	(13)	(14)	(15)	(16)
Test No.	10/1-2	10/1-2	10/1-2	10/1-2
Date	8-23-76	8-23-76	8-24-76	8-24-76
Time	13:50	15:30	13:25	15:20
Steam Flow, lb/hr $\times 10^{-3}$	165-180	175-205	200-235	220-250
Steam Outlet Press., psig	840	840	870	830
Steam Outlet Temp., °F	750-810	790	785	785
Burner Gas Press., psig	8.9	2.0	1.9	1.9
Furnace Draft, in. H_2O	-.5	-.5	-.4	-.3
Main Undergrate Air Press., in. H_2O	—	—	—	—
Primary Air Press., in. H_2O	—	—	—	—
A.H. Air Outlet Press., in. H_2O	6	6.2	6.2	6.2
A.H. Air Inlet Press., in. H_2O	8	8	7.7	7.6
F.D. Fan Discharge Press., in. H_2O	8.1	8	7.8	8.0
Low. Overfire Air Press., in. H_2O	26	26	26	26
Up. Overfire Air Press., in. H_2O	27.5	27	27.5	27
I.D. Fan Inlet Draft, in. H_2O	-8	-7.6	-7.8	-7.8
A.H. Gas Out, in. H_2O	-4.4	-4.2	-4.3	-4.4
Boiler Outlet Draft, in. H_2O	-3	2.5	-2.7	-2.5
Undergrate Air Flow, percent	38.5	38	39	38.5
Wood Steam Flow, percent	38-52	50-65	62-72	68-75
Windbox Air Flow, percent	29	29	28	28
Total Air Flow, percent	61	60	61.5	61
Gas Flow to Burners, SCFH	113000	81000	85000	84000
Boiler Outlet O_2, percent	3.5-6.5	4-6	1-3	0-6.8
Boiler Outlet Comb., percent	0	0	.0	0
Air Heater Air In, °F	106	110	105	109
Air Heater Air Out, °F	570	580	598	599
Boiler Gas Out, °F	710	702	717	718
Attemp. Steam Out, °F	668	672	659	665
Undergrate Air, °F	522	530	548	542
A.H. Gas Out, °F	488	495	508	510
I.D. Fan Gas In, °F	490	500	510	515
Feedwater Temp., °F	291	292	291	290
Wood Feedscrews Load, ~~percent~~ RPH, 1/2/3	7 | 7 | 7	5.5 | 5.5 | 5.5	7 | 7 | 7.5	7.5 | 7.5 | 8
Air Heater Air Inlet Damper Percent Open	100	100	100	100
Tempering Air Damper Percent Open	0	0	0	0
Gas Burners In Service	1,2,3	1,2,3,4	1,2,3,4	1/2/3/4
Register Setting Percent Open 1/2	8 | 90	80 | 90	50 | 60	50 | 60
3/4	100 | 0	50 | 75	35 | 60	35 | 60
Comments:	№4 BURNER OOS	ALL BRN. IN SERVICE. LOWER GAS FLOW. REG. ADJUSTMENT	4 BRNS. REGISTER ADJUSTM. STABLE GAS FLOW. HIGH WOOD FLOW. PARTIC. TEST	4 BRN. IN SERV. REG. ADJ. STABLE GAS FLOW HIGH WOOD FLOW BRINK TEST

LOCATION 10/1

FUEL GAS CHROMATOGRAPHIC ANALYSIS

CHROMATOGRAPH ANALYSIS:	MOL %	GPM @ 14.65 PSIA
CARBON DIOXIDE	0.10	
NITROGEN	0.88	
METHANE	95.64	
ETHANE	2.04	
PROPANE	0.70	0.192
ISO-BUTANE	0.15	0.049
N-BUTANE	0.21	0.066
ISO-PENTANE	0.06	0.022
N-PENTANE	0.06	0.022
HEXANES PLUS	0.16	0.068
	100.00	0.419

SPECIFIC GRAVITY @ 60° F. (AIR = 1) 0.5891

B.T.U./CU. FT. @ 14.696 PSIA AND 60°F.:
DRY BASIS 1044
WET BASIS 1026

LOCATION 10

Unit 1

FUEL ANALYSIS

Test 10/1-2 August 19, 1976 5:15 p.m.

	Basis	
	As received	Dry
Proximate analysis:		
Moisture, %	50.69	---
Volatile matter, %	36.54	74.10
Ash, %	2.27	4.60
Fixed carbon, %	10.50	78.70
Ultimate analysis:		
Moisture, %	50.69	---
Carbon, %	25.32	51.34
Hydrogen, %	2.73	5.54
Nitrogen, %	0.15	0.31
Sulfur, %	0.05	0.11
Ash, %	2.27	4.60
Oxygen, % (by difference)	18.79	38.10
Heat of Combustion:		
Gross BTU/lb	4362	8845
Net BTU/lb	4108	8331

10/1-3

PARTICULATE EMISSION CALCULATIONS Meth 5

Test No. _____

Test No. 10/1-1 Date 8-18-76 Location 10 Engr. [illegible]

Unit No. 1 Fuel N.G. & Wood Load 175 - 200 K #/Hr.

Pitot Factor, Fs .84 Barometric Pressure, P_{bar} 29.8 in. Hg

Tot. Liquid Collected, V_{lc} 222 ml Total Particulate, M_n 1925.3 m gm

Velocity Head, ΔP .05 iwg Stack Temp., Ts 912 °R Stack Area, As 262.5 ft^2

Sample Volume, Vm 62.52 ft^3 Stack Press., Psg -4.7 iwg Excess O_2, XO_2% 9.0 %

Orifice Press. Diff., H .56 iwg Stack Gas Sp. Gravity, Gs 1.01 n.d. est.

Sample Time, θ 120 min Nozzle Diameter, Dn .5 in.

1. Sample Gas Volume $Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$ — 62.31 SCF
2. Water Vapor $Vw_{std} = 0.0474\ V_{lc}$ — 10.52 SCF
3. Moisture Content Bwo = Eq. 2/(Eq. 1 + Eq. 2) — .144 N.D.
4. Concentration a. $C = 0.0154\ Mn/Vm_{std}$ — .4758 grains/DSCF
   b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$ — 6.813×10^{-5} lb/DSCF
   c. C = Eq. 4b x 16.018×10^3 — 1.091 grams/DSCM
5. Abs. Stack Press. $Ps = P_{bar} \times 13.6 + Psg$ — 400.58 in. w abs.
6. Stack Gas Speed $Vs = 174\ Fs\ \sqrt{\Delta PTs}\sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$ — 989.93 ft/min
7. Stack Gas Flow Rate @ 70°F a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$ — 148631 WSCF/min
   b. Qsd = Eq. 7a x (1. - Eq. 3) — 127228 DSCF/min
8. Material Flow Ms = Eq. 7b x Eq. 4b x 60 — 520.08 lb/hr
9. XO_2 factor $XO_2f = 2090/(20.9 - XO_2\%)$ — 175.63 N.D.
10. Emission a. E = Eq. 4b x Fe x Eq. 9 — 1.1605 lb/MMBtu
    b. E = Eq. 4c x Fm x Eq. 9 x 1000 — 498.77 ng/joule
11. % Isokinetic $I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$ — 78.6 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

Fe 96.99
Fm .002603 See calc.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS Test No._____

Modif. Meth. 5

Test No. 10/1-1 Date 8-18-76 Location 10 Engr. Ki

Unit No. 1 Fuel N.G. & Wood Load 175 - 200 K #/Hr.

Pitot Factor, Fs .84 Barometric Pressure, P_{bar} 29.8 in. Hg

Tot. Liquid Collected, V_{lc} 222 ml Total Particulate, M_n 1952.8 m gm

Velocity Head, ΔP .05 iwg Stack Temp., Ts 912 °R Stack Area, As 262.5 ft^2

Sample Volume, Vm 62.52 ft^3 Stack Press., Psg -4.7 iwg Excess O_2, XO_2% 9.0 %

Orifice Press. Diff., H .56 iwg Stack Gas Sp. Gravity, Gs 1.01 n.d. est.

Sample Time, θ 120 min Nozzle Diameter, Dn .5 in.

1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	62.81	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	10.52	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.144	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	.4826	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	6.910×10^{-5}	lb/DSCF
	c. $C = Eq.\ 4b \times 16.018 \times 10^3$	1.107	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	400.58	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs\ \sqrt{\Delta PTs}\sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	989.93	ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	148631	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	127228	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	527.51	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	175.63	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	1.1771	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	505.89	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	78.6	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm •SC Meters/10^4 joules	0.002475	0.002346	0.002636

Data Sheet 6002-4

(10/1-15) PARTICULATE EMISSION CALCULATIONS Test No. _____

Test No. 10/1-2 Date 8-24-76 Location 10 Engr. K.

Unit No. 1 Fuel N.G. & Bark Load 200 - 235 x 10^3 PPH

Pitot Factor, Ps .84 Barometric Pressure, P_{bar} 29.95" in. Hg

Tot. Liquid Collected, V_{lc} 327.9 ml Total Particulate, M_n 6074.6 m gm

Velocity Head, ΔP .13 iwg Stack Temp., Ts 930 °R Stack Area, As 262.5" ft^2

Sample Volume, Vm 71.62 ft^3 Stack Press., Psg -4.3 iwg Excess O_2, XO_2% 7.0 %

Orifice Press. Diff., H .77 iwg Stack Gas Sp. Gravity, Gs 1.01 n.d. est.

Sample Time, θ 120 min Nozzle Diameter, Dn .375" in.

1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	71.78 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	15.54 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.178 N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	1.3033 grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	1.266×10^{-4} lb/DSCF
	c. C = Eq. 4b x 16.018 x 10^3	.9 g/DSCF 2.989 grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	403.02 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs\ \sqrt{\Delta P Ts}\ \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	1606.99 ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	22252 WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	195677 DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	2190.8 lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	150.36 N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	3.108 lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	1336.59 ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	104.6 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

Fc = 110.78
Fm = .002974 See calcul.

Data Sheet 6002-4

10/1-15

PARTICULATE EMISSION CALCULATIONS

Test No. _____

Test No. 10/1-2 Date 8-24-76 Location Mod. 1 Melt 3 10 Engr. K.

Unit No. 1 Fuel N.G. & Boiler Load 200-285 x 10³ PPH

Pitot Factor, Ps .84 Barometric Pressure, P_{bar} 29.95 in. Hg

Tot. Liquid Collected, V_{lc} 327.9 ml Total Particulate, M_n 617.5-6 m gm

Velocity Head, ΔP .13 iwg Stack Temp., Ts 930 °R Stack Area, As 2[illegible] ft^2

Sample Volume, Vm 71.62 ft^3 Stack Press., Psg -4.3 iwg Excess O_2, XO_2% 7.0 %

Orifice Press. Diff., H .77 iwg Stack Gas Sp. Gravity, Gs 1.01 n.d.

Sample Time, θ 120 min Nozzle Diameter, Dn .375 in.

1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	71.78	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	15.54	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.178	M.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	1.3142	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	1.882×10^{-4}	lb/DSCF
	c. C = Eq. 4b x 16.018×10^{3}	3.0141	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	403.02	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs\ \sqrt{\Delta P Ts}\ \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	1606.94	ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	238.050	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	195.677	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	2209.2	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	150.36	M.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	2.1341	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	1247.91	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	104.6	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

Data Sheet 6002-4

PARTICULATE CALCULATION SHEET

Test No. 10/1-1 Date 8-19-76 Location 10 Test Crew _____

Box No. 1 Sample Probe Position _____

Test Description BASELINE

Dry Gas Meter Vol. (ft^3)

Final 1414.28

Initial 1351.76

Total 62.52

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final	338	70	⊖	674.7	1082.7
Initial	100	100	⊖	660.7	860.7
Δ Vol	238	-30	⊖	14.0	222.0

Beaker No.		1	2	3		4	Filter No. 5	Blank No. 6
Date Weighed		8-17-76						→
Tare Wt.	1	100.0933	101.6240	101.9863		99.2625	.8426	.8077
	2	100.0934	101.6243	101.9865		99.2626	.8428	.8078
	3							
	4							
	5							
	6							
	Avg	100.0934	101.6242	101.9864		99.2625	.8427	.8078
Bottle No.		1 + 2	3	4				
Content		Impinger (Water)	Probe (Acetone)	Probe (Water)	~~Cyclone (Acetone)~~	Flask (Dry)		
Rinse (ml)		725	575	420				
Date Weighed or 250 Bake		8-20-76				→	8-19-76	8-19-76
Final Wt. 250	1	100.1134	102.3532	101.9967		100.3378	.9636	.8078
	2	100.1135	102.3532	101.9966		100.3379	.9637	.8078
	3						.9636	
	4							
	5							
	6							
	Avg	100.1135	102.3532	101.9967		100.3379	.9636	.8078
Residue wt Final 250-Tare		.0201	.7290	.0103		1.0754	.1209	⊖
Date Weighed or 650 Bake								
Final Wt. 650	1							
	2							
	3							
	4							
	5							
	6							
	Avg							
Residue Wt Final 650-Tare								

Comments:

Data Sheet 6002-3

PARTICULATE CALCULATION SHEET

Test Crew _____

Test No. 10/1-2 Date 8-24-76 Location 10

Box No. _____ Sample Probe Position _____

Test Description

Dry Gas Meter Vol. (ft^3)

Final 1490.46

Initial 1418.84

Total 71.62

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final	366	144	1	672.7	1193.7
Initial	100	100	0	655.8	855.8
Δ Vol	266	44	1	16.9	327.9

Beaker No.	5	6	7		8	Filter No. 6	Blank No. 7
Date Weighed	8-17-76				→	8-17-76	8-17-76
Tare Wt. 1	98.9356	100.4810	104.0027		99.3357	.8077	.8469
2	98.9359	100.4812	104.0029		99.3354	.8078	.8470
3							
4							
5							
6							
Avg	98.9358	100.4811	104.0028		99.3356	.8078	.8470
Bottle No.	1+2	3	4				
Content	Impinger (Water)	Probe (Acetone)	Probe (Water)	~~Cyclone (Acetone)~~	Flask (Dry)		
Rinse (ml)	1000	750	450				
Date Weighed or 250 Bake	8-26-76	8-26-76	8-26-76		8-25-76	8-25-76	8-25-76
Final Wt. 250 1	98.9764	101.2715	104.0152		104.1333	1.2984	.8469
2	98.9769	101.2717	104.0153		104.1333	1.2986	.8469
3						1.2989	
4							
5							
6							
Avg	98.9769	101.2716	104.0153		104.1333	1.2987	.8469
Residue wt Final 250-Tare	.0411	.7905	.0125		4.7977	.4909	0
Date Weighed or 650 Bake							
Final Wt. 650 1							
2							
3							
4							
5							
6							
Avg							
Residue Wt Final 650-Tare							

Comments:

Data Sheet 6002-3

PLANT
LOCATION 10
OPERATOR
DATE 1-18-78
RUN NO. 10/1-1
SAMPLE BOX NO. 1
METER BOX NO. 1
METER H
C FACTOR @ .83

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 85°F
BAROMETRIC PRESSURE 29.8 in. Hg
ASSUMED MOISTURE, %
HEATER BOX SETTING 7-5-3
PROBE LENGTH, IN. 48
NOZZLE DIAMETER, IN. 1/2
PROBE HEATER SETTING 3-1

PARTICULATES

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time (e) Min. Clock Time	Static Pressure (P_g), ~~In. Hg.~~ in wg	Stack Temperature (T_s) °F	Velocity Head ΔP (R_s) in wg	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume METER READING (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter: Inlet ($T_{min.}$) °F	Gas Sample Temperature at Dry Gas Meter: Outlet (T_{mout}) °F	Sample Box Temprtature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
	1102:40	-4.7	450	.05	.56	1351.76		95	310	70
	1117:40		450	.05	.56	1360.00		90	350	60
	1132:40		450	.05	.56	1368.00		100	300	70
	1147:40		450	.05	.56	1376.00		105	320	70
	1202:40		450	.05	.56	1384.00		105	320	65
	1217:40		450	.05	.56	1391.50		110	320	60
	1232:40		450	.05	.56	1399.00		115	335	60
	1247:40		460	.05	.56	1406.00		120	340	60
	1302:40		460	.05	.56	1414.28		120	335	65
	120 min.					62.52 ft^3				
TOTAL								AVG.	AVG.	
AVERAGE			452					AVG.		

PLANT
LOCATION 10
OPERATOR
DATE 8-18-76
RUN NO. 10/1-1
SAMPLE BOX NO. 1
METER BOX NO. 1
METER H
C FACTOR 0 .83

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 94°F
BAROMETRIC PRESSURE 29.7 in. Hg
ASSUMED MOISTURE, % ~15
HEATER BOX SETTING
PROBE LENGTH, IN. 48
NOZZLE DIAMETER, ~~IN.~~ 4 mm
PROBE HEATER SETTING

BRINK IMPACTOR

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time (e) Min. CLOCK TIME	Static Pressure (P_g), ~~In. Hg.~~ in. w.g	Stack Temperature (T_s) °F	Velocity Head (P_g)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume METER READING (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temperature °F	Temperature of Gas Leaving Condenser or Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
	1435	-5.0	480		.005	1414.30		95		70
	1445		480		.006	1416.00		95		70
	1450		480		.006	1417.00		95		70
	1456		480		.006	1418.00		98		70
	1459					1418.64				
	24									
TOTAL								AVG.	AVG.	
AVERAGE										

PLANT
LOCATION 10
OPERATOR
DATE 8-24-78
RUN NO. 10/1-2
SAMPLE BOX NO. 1
METER BOX NO. 1
METER H
C FACTOR @ .83

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 93 °F
BAROMETRIC PRESSURE 29.95 in. Hg
ASSUMED MOISTURE, % ~15
HEATER BOX SETTING 2.5
PROBE LENGTH, IN. 48
NOZZLE DIAMETER, IN. 3/8
PROBE HEATER SETTING 2.0

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time (e) Military CLOCK TIME	Static Pressure (P_s), In. Hg. H_2O	Stack Temperature (T_s) °F	Velocity Head Δp (R_h) iwg	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume METER READING (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
	1140	-4.3	410	.13	.77	1418.84		105	310	35
	1155		420	.13	.77	1428.44		105	350	80
	1210		460	.13	.77	1437.75		110	320	65
	1225		480	.13	.77	1446.63		115	320	65
	1240		470	.13	.77	1455.49		119	330	62
	1255		470	.13	.77	1464.65		120	320	65
	1310		470	.13	.77	1473.00		120	310	65
	1325		470	.13	.77	1481.50		120	310	65
	1340	↓	460	.13	.77	1490.46		120	320	68
	120 min									
TOTAL								AVG.	AVG.	
AVERAGE										

PLANT
LOCATION 10
OPERATOR
DATE 8-24-76
RUN NO. 10/1-2
SAMPLE BOX NO. 1
METER BOX NO. 1
METER H
C FACTOR @ .83

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 93 °F
BAROMETRIC PRESSURE 29.85 in. Hg
ASSUMED MOISTURE, % ~15
HEATER BOX SETTING
PROBE LENGTH, IN. 48
NOZZLE DIAMETER, IN. 4mm
PROBE HEATER SETTING

BRINK IMPACTOR

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time (θ) Min. CLOCK TIME	Static Pressure (P_g), In. ~~Hg~~ H_2O	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume METER READING (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprtature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
	1440	-4.4	405		.03	1490.50		110		
	1445	↓	430		.03	1491.10		105		
	1450		415		.04	1491.70		110		85
	1455					1492.52				
	15 min.									
TOTAL										
AVERAGE								AVG.	AVG.	

Test No. 10/1-1

(4) CASCADE IMPACTOR DATA SHEET

TEST RUN NO. 10/1-1 LOCATION 10 DATE 8-18-76

IMPACTOR NO. 1 CYCLONE NO. NONE OPERATOR R. PIONESSA

SAMPLE POINT LOCATION DOWNSTREAM OF A.H., BEFORE DUST COLLECTOR

SUBSTRATE COATING NONE FUEL BARK + FUEL TEST LOAD 170-190 klb/hr

IMPACTOR ORIENTATION HORIZ. FLOW THRU IMPACTOR _____ CFM

FLUE STATIC PRESSURE -5.0 inH_2O, VELOCITY 991 ft/min

NOZZLE DIA. 4 mm IMPACTOR PRESSURE DROP 14.1 "H_2O END TIME 1459

GAS METER END 1418.64 CF START TIME 1435

GAS METER START 1414.30 CF DURATION 24 min

GAS VOLUME 4.34 CF FLOW RATE .18 CFM

AMBIENT TEMPERATURE 94 °F PRESSURE 29.7 IN Hg. HUMIDITY 47 %

FLUE GAS MOLECULAR WT. _____, TEMP. 480 °F, DENSITY _____ g/cc, VISCOSITY _____ POISE

	Stage Number							Stage Blank
	1	2	3	4	5			
Foil + Sample, g	3.6742	3.2542	3.6496	3.2327	3.7541			
Unused Foil, g	3.6589	3.2449	3.6485	3.2329	3.7535			
Sample, g	.0153	.0093	.0011	-.0002	.0006			
Correction for Blank, g				*				
Final Sample, g								

* NOZZLE TO 4th STAGE PLUGGED BY WOOD CHIP

FILTER NO.	Sample	Blank
FILTER + SAMPLE, g	.0360	
FILTER TARE, g	.0384	
SAMPLE, g	-.0024	
CORRECTION FOR BLANK, g	0	
FINAL SAMPLE, g	-.0024	

FULL CONTAINER, g _____

EMPTY CONTAINER, g _____

CYCLONE CATCH, g _____

Test No. 10/1-2

(16) CASCADE IMPACTOR DATA SHEET

TEST RUN NO. 10/1-2 LOCATION 10 DATE 8-24-76

IMPACTOR NO. 1 CYCLONE NO. 1 OPERATOR R. PIONESSA

SAMPLE POINT LOCATION DOWNSTREAM OF A.H., BEFORE DUST COLLECTOR

SUBSTRATE COATING NONE FUEL N.G. + WOOD BARK TEST LOAD 220-250 klb/hr

IMPACTOR ORIENTATION HORIZ. FLOW THRU IMPACTOR _____ CFM

FLUE STATIC PRESSURE -4.4 inH_2O, VELOCITY 1563 ft/min.

NOZZLE DIA. 4 mm IMPACTOR PRESSURE DROP 14" END TIME 1455

GAS METER END 1492.52 CF START TIME 1440

GAS METER START 1490.50 CF DURATION 15 min

GAS VOLUME 2.02 CF FLOW RATE .13 CFM

AMBIENT TEMPERATURE 93 °F PRESSURE 29.85 IN Hg. HUMIDITY 52 %

FLUE GAS MOLECULAR WT. _____, TEMP. 416 °F, DENSITY _____ g/cc, VISCOSITY _____ POISE

	Stage Number							Stage Blank
	1	2	3	4	5			
Foil + Sample, g	4.0928	3.6851	4.0807	3.6709	4.1757			
Unused Foil, g	4.0892	3.6839	4.0798	3.6703	4.1752			
Sample, g	.0036	.0012	.0009	.0006	.0005			
Correction for Blank, g								
Final Sample, g								

IMPACTOR PLUGGED AFTER 15 MIN.

FILTER NO.	Sample	Blank
FILTER + SAMPLE, g	1.2007	
FILTER TARE, g	1.2027	
SAMPLE, g	-.0020	
CORRECTION FOR BLANK, g		
FINAL SAMPLE, g		

FULL CONTAINER, g .4660

EMPTY CONTAINER, g .4253

CYCLONE CATCH, g .0407

TABLE 1. TEST 10/1-2 (16)

	Symbol	Value
Pressure drop across impactor during test "Hg"	ΔP_2	1.04
Static pressure at inlet to impactor, atm.	P_2	0.99
Density of aerosol particle, grams/cc	P_p	1.5
Density of gas at inlet sampling conditions, grams/cc	P_2	7.2×10^{-4}
Molecular weight of sample gas	MW_2	29
Molecular weight of calibration gas	MW_1	29
Temperature of gas at sampling conditions, °K	T_2	487
Temperature of gas at calibration conditions, °K	T_1	298
Static pressure under calibration conditions, atm.	P_1	1
Gas viscosity at sampling conditions, poises	μ	2.5×10^{-4}
Stage jet diameter, cm	D_{c_2}	0.249
	D_{c_3}	0.1775
	D_{c_4}	0.1396
	D_{c_5}	0.0946
	D_{c_6}	0.0731
Sample quantity collected on each cup, mg	R_2	3.6
CYCLONE = 40.7 mg TOTAL = 47.5	R_3	1.2
	R_4	0.9
	R_5	0.6
	R_6	0.5
	R_7	0
Dimension conversion constant	g_c	1

TABLE 2.

	Symbol	Value
Effective pressure drop, "Hg"	ΔP_E	1.72
Inlet flow to impactor, cc/second	F	31.15
Pressure out of stages, atm.	P_{S_2}	0.99
	P_{S_3}	0.99
	P_{S_4}	0.99
	P_{S_5}	0.98
	P_{S_6}	0.955
Density of gas out of the various stages, grams/cc	P_{S_2}	7.2×10^{-4}
	P_{S_3}	7.2×10^{-4}
	P_{S_4}	7.2×10^{-4}
	P_{S_5}	7.1×10^{-4}
	P_{S_6}	6.9×10^{-4}
Characteristic diameter, microns	D_{pc_2}	3.97
	D_{pc_3}	2.34
	D_{pc_4}	1.59
	D_{pc_5}	0.82
	D_{pc_6}	0.51
Criteria for validity of equation 18	$\frac{D_{pc_6} \times 10^{-4}}{L}$	4.2
Mean free path	L	1.21×10^{-5}
Average molecular velocity	$\bar{v}$	59,750

Continued

TABLE 2 (Continued)

	Symbol	Value w/out cyclone	Value with cyclone
% on a cup of the total sample collected			85.7 (7μ cyclone)
Stage 2	γ_2	53.0	7.6
3	γ_3	17.6	2.53
4	γ_4	13.2	1.89
5	γ_5	8.8	1.26
6	γ_6	7.4	1.05
Filter	γ_7	0	0
	Total	100.00*	
*Any discrepancy due to rounding off should be buried in the largest γ cumulative % smaller than D_{pc}			100.00
			14.33
	Σ_2	47.0	6.73
	Σ_3	29.4	4.20
	Σ_4	16.2	2.31
	Σ_5	7.4	1.05
	Σ_6	0	0

PLUME OPACITY OBSERVATION RECORD

Test Run No. 10/1-1

LOCATION NO. _____ OBSERVER Hami

OWNER _____ BOILER NO. 1 (V.O) CAPACITY 200 (Grate) klb/hr

DATE AUG 18 1976 FUEL TYPE Wood/bark BURNER TYPE Spreader

POINT OF EMISSION Stack (Black Liquor Blr 005)

POINT OF OBSERVATION 200 yards east of stack

TEST No.	Time am/pm	Type	Test Load kŧ/hr	Opacity %	WIND Speed mph	WIND Direct.	Sky Cond.	Sun Position	Comments
	11:15	Partic	200	5	—	—	clear	Behind of observer	
	11:17			5					
	11:19			5					
	11:21			5					
	11:23			5					
	11:25			5					
	11:27			5					
	11:29			5					
	11:31			5					
	11:33			5					
	11:35			5					
	11:37			5					
	11:39			5					
	11:41			5					
	11:43			5					
	11:45			5					

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 8-8-76 _____

Location: 10 _____

Unit: 1 _____

Test: 10/1-1 Personnel: _____

Fuel: _____

Barometric Press. (in. Hg): _____

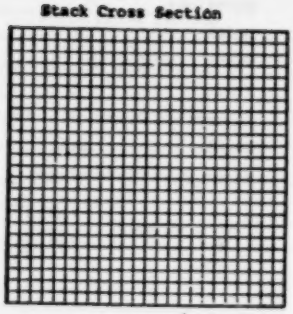
Absolute Static Press. in Stack (in. Hg): _____ (P_g)

Pitot Tube Coefficient: _____ (C_p)

$$V_g = 85.48\, C_p \left[\frac{T_g \Delta P}{P_g M_s}\right]^{1/2}$$

PARTIC. + BRINK

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O)	Gas Temp. (°F)	Gas Temp. (°R)	Molecular Wt.	Velocity (ft/sec)	O_2 Conc. (% Dry)
		BAND	ΔP		T_g	M_s	V_g	
		1	.07					
		2	.06					
		3	.05					
		4	.09					
		5	.05					
		6	.05					
		7	.05					

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: AUG. 24, 1976 _____

Location: 10 _____

Unit: 1 _____

Test: 10/1-2 Personnel: _____

Fuel: _____ _____

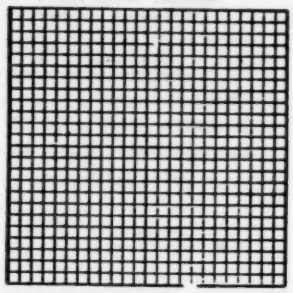
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): _____ (P_g)

Pitot Tube Coefficient: _____ (C_p)

$$V_g = 85.48\ C_p \left[\frac{T_g \Delta P}{P_g M_s}\right]^{1/2}$$ PARTIC. + BRINK

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O)	Gas Temp. (°F)	Gas Temp. (°R)	Molecular Wt.	Velocity (ft/sec)	O_2 Conc. (% Dry)
		BAND	ΔP		T_g	M_s	V_g	
		1	.16					
		2	.15					
		3	.13					
		4	.16					
		5	.17					
		6	.14					

6002-13

BLACK LIQUOR RECOVERY BOILER

Location No. 10 Unit No. 2

Unit Description BLACK LIQUOR RECOVERY BOILER
97500 kg/hr (215,000 lb/hr)

Installation Date 1965

Heater Rating

Burner Description COMBUSTION ENGINEERING BLACK LIQ BURNER

Test Fuel Combinations BLACK LIQUOR

Fuel Temp. at Burner (°F) 394 K (250 °F)

Primary Air Temp. (°F) 422 K (300 °F)

Comments:

10/2-1, -2,

MOBILE LABORATORY DATA

Test No. -3

10/2-1, -2, 8-26, -27,

Test No. -3 Date 8-30-76 Location 10 Engr. H. BUENING

Unit No. 2 Fuel Blk. Liqu. Capacity 215 $\times 10^3$ lbs/Hr

Unit Type CE RECOVERY Blr. Burner Type

1. Test No.	10/2-1		10/2-2		10/2-3							
2. Date	8-26-76		8-27-76		8-30-76							
3. Time	10:55		14:30		16:00							
4. Load	178		195									
5. Process Rate												
6. Flue Diam. or Size, ft	39'×22'4"											
7. Probe Position	~3'4" in											
8. Oxygen (%)	4.4		3.8		3.7							
9. NOx (hot) read/3% O_2 (ppm)			37	39	22	23						
10. NO (hot) read/3% O_2 (ppm)			34	36	20	21						
11. NO_2 (hot) read/3% O_2 (ppm)			3	3	2	2						
12. NO (cold) read/3% O_2 (ppm)	42		46	48	31	32						
13. Carbon Dioxide (%)	14.4		14.4		15.4							
14. Carbon Monoxide (ppm) uncor/cor	>2000		>2000	>2000	>2000	>2000						
15. Hydrocarbon (ppm) uncor/cor			477-850	497-880	1050-1700	1042-1769						
16. Sulfur Dioxide (ppm) uncor/cor			320	335	320-360	333-375						
17. Smoke Spot (Bacharach)			—		—							
18. Atmos. Temp. (°F/°C)	84		84		85							
19. Dew Point Temp. (°F/°C)	75		74		77							
20. Atmos. Pressure (in. Hg)	29.90		29.85		29.91							
21. Relative Humidity (%)	67		63		70							
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

BASELINE. CONFIGURATION IN HOT LINE

BASELINE METIC. TEST

BASELINE SOx

Data Sheet 6002-2

10/2-4, -5,

MOBILE LABORATORY DATA

Test No. -6

10/2-4, -5,

Test No. -4 Date 8-31-76 Location 10 Engr. BUENING

Unit No. 2 Fuel Blck. Liqu. Capacity 215 x 10^3 PPH

Unit Type CE Recovery Blr Burner Type

1. Test No.	10/2-4		10/2-5		10/2-6						
2. Date	8-31-76		8-31-76		8-31-76						
3. Time	9:30		1352		1629						
4. Load	200		195		175						
5. Process Rate											
6. Flue Diam. or Size, ft											
7. Probe Position	①		1		1						
8. Oxygen (%)	3.4		4.7		3.5						
9. NOx (hot) read/3% O_2 (ppm)	23	24	28	31	22	23					
10. NO (hot) read/3% O_2 (ppm)	22	22	27	30	20	21					
11. NO_2 (hot) read/3% O_2 (ppm)	1	1	1	1	2	2					
12. NO (cold) read/3% O_2 (ppm)	31	32	34	38	32	33					
13. Carbon Dioxide (%)	14.4		14.6		15.1						
14. Carbon Monoxide (ppm) uncor/cor	>	>	Excess 2000	—	> 2000	—					
15. Hydrocarbon (ppm) uncor/cor	1625	1662	500-1000	552-1104	1000-1900	1039-1949					
16. Sulfur Dioxide (ppm) uncor/cor	180	184	200	221	400	411					
17. Smoke Spot (Bacharach)	—		—		—						
18. Atmos. Temp. (°F/°C)	77		85		87						
19. Dew Point Temp. (°F/°C)	76		78		78						
20. Atmos. Pressure (in. Hg)	29.88		29.88		29.82						
21. Relative Humidity (%)	96		74		68						
22.											
23.											
24.											
25.											
26.											
27.											
28.											
29.											
30.											

>: INSTRUMENT PEGGED OUT.

BASELINE

SEC. MANIFOLD 100% OPEN SOx

SEC. MAN. 46% OPEN

Data Sheet 6002-2

10/2-7,-8,

MOBILE LABORATORY DATA

10/2-7,-8,
Test No. -9

Test No. -9 Date 9-1-76 Location 10 Engr. BUENING

Unit No. 2 Fuel Blck. Liqu. Capacity 215 x 10^3 PPH

Unit Type CE RECOVERY BLR. Burner Type

1. Test No.	10/2-7		10/2-8		10/2-9						
2. Date	9-1-76		9-1-76		9-1-76						
3. Time	0900		10:30		11:15						
4. Load	185		200		195						
5. Process Rate											
6. Flue Diam. or Size, ft											
7. Probe Position											
8. Oxygen (%)	3.3		3.7		4.1						
9. NOx (hot) read/3% O_2 (ppm)	13	13	17	18	19	20					
10. NO (hot) read/3% O_2 (ppm)	12	12	17	18	18	19					
11. NO_2 (hot) read/3% O_2 (ppm)	1	1	0	0	1	1					
12. NO (cold) read/3% O_2 (ppm)	21	21	25	26	29	31					
13. Carbon Dioxide (%)	13.3		14.0		14.4						
14. Carbon Monoxide (ppm) uncor/cor	EXCESS →		>2000		>2000						
15. Hydrocarbon (ppm) uncor/cor	4000	4068	1800-2800	1873-2913	3650	3888					
16. Sulfur Dioxide (ppm) uncor/cor	220	224	220	229	240	256					
17. Smoke Spot (Bacharach)	—		—		—						
18. Atmos. Temp. (°F/°C)	80		83		86						
19. Dew Point Temp. (°F/°C)	77		77		77						
20. Atmos. Pressure (in. Hg)	29.83		29.84		29.84						
21. Relative Humidity (%)	89		79		68						
22.											
23.											
24.											
25.											
26.											
27.											
28.											
29.											
30.											

BASELINE W GAS

BASELINE LOW SOLIDS

BASELINE LOW SOLIDS SO_x

Data Sheet 6002-2

10/2-10,-11,

MOBILE LABORATORY DATA

Test No. -12

10/2-10,-11 9-15-76

Test No. -12 Date 9-16-76 Location 10 Engr. WOOD

Unit No. 2 Fuel Blk. Liq. Capacity 315K 16/hr

Unit Type Blk Liq. + Rec. Boiler Burner Type Liquor Burner

1. Test No.	10/2-10		10/2-11		10/2-12		10/2-12					
2. Date	9-15-76		9-16-76		9-16-76		9-16-76					
3. Time	1420		0830		1445		1525					
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position												
8. Oxygen (%)	4.7		4.05		7.8		8.6					
9. NOx (hot) read/3% O_2 (ppm)	23	25	25	27	46		40	58				
10. NO (hot) read/3% O_2 (ppm)	21	23	25	27	45		40	58				
11. NO_2 (hot) read/3% O_2 (ppm)	2	2	0	0	1		0	0				
12. NO (cold) read/3% O_2 (ppm)	33	36	31	33	58		58	84				
13. Carbon Dioxide (%)	14.0		12.4		11.6		11.8					
14. Carbon Monoxide (ppm) uncor/cor	27200	30037	9438	10023	80		70	102				
15. Hydrocarbon (ppm) uncor/cor	1500	1658	COLD		10		5	7				
16. Sulfur Dioxide (ppm) uncor/cor	460	508	COLD		20		2	3				
17. Smoke Spot (Bacharach)	—		—		—		—					
18. Atmos. Temp. (°F/°C)	88						89					
19. Dew Point Temp. (°F/°C)	76						73					
20. Atmos. Pressure (in. Hg)	29.94		29.98				29.40					
21. Relative Humidity (%)	58						47					
22.												
23.												
24.												
25.												
26.	BLACK LIQUOR ONLY		BASELINE + NATURAL GAS FUEL		BLACK LIQUOR ONLY							
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 10/2-14

Test No. 10/2-14 Date 9-22-76 Location 10 Engr. WOOD

Unit No. 2 Fuel BLACK LIQ. Capacity

Unit Type RECOVERY BOILER / BLK. LIQ. Burner Type

1. Test No.	10/2-14		10/2-14		10/2-14		10/2-14		10/2-14	
2. Date	9-22-76		9-22-76		9-22-76		9-22-76		9-22-76	
3. Time	1630		1640		1644		1650		1505	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	ESP IN		ESP OUT		ESP OUT		ESP OUT		ESP OUT	
8. Oxygen (%)	4.9		8.8						8.1	
9. NOx (hot) read/3% O_2 (ppm)	26	29	—							
10. NO (hot) read/3% O_2 (ppm)	26	29	—							
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	—							
12. NO (cold) read/3% O_2 (ppm)	42	47	35	52					43	60
13. Carbon Dioxide (%)	13.2		9.5		11.3				12.0	
14. Carbon Monoxide (ppm) uncor/cor	1695	1895	620	915	3616		2335		3850	5372
15. Hydrocarbon (ppm) uncor/cor	875	978	—						—	
16. Sulfur Dioxide (ppm) uncor/cor	120	134	—						—	
17. Smoke Spot (Bacharach)	—		—						—	
18. Atmos. Temp. (°F/°C)	80		80						80	
19. Dew Point Temp. (°F/°C)	66		66						66	
20. Atmos. Pressure (in. Hg)	29.80		29.80						29.80	
21. Relative Humidity (%)	48		48						48	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 10/2-14

Test No. 10/2-14 Date 9-22-76 Location 10 Engr. WOOD

Unit No. 2 Fuel BLK. LIQ. Capacity

Unit Type RECOVERY / BLK. LIQ. Burner Type

1. Test No.	10/2-14		10/2-14		10/2-14		10/2-14		10/2-14	
2. Date	9-22-76		9-22-76		9-22-76		9-22-76		9-22-76	
3. Time	1835		1850		2005		2015		2023	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	ESP IN		ESP OUT		ESP IN		ESP OUT		COMP.	
8. Oxygen (%)	4.5		7.2		4.4		7.1		6.0	
9. NOx (hot) read/3% O_2 (ppm)	24	26	—		23	25	—		—	
10. NO (hot) read/3% O_2 (ppm)	22	24	—		18	20	—		—	
11. NO_2 (hot) read/3% O_2 (ppm)	2	2	—		5	5	—		—	
12. NO (cold) read/3% O_2 (ppm)	35	38	29	38	33	36	31	40	30	36
13. Carbon Dioxide (%)	14.4		11.4		14.8		12.0		12.8	
14. Carbon Monoxide (ppm) uncor/cor	19717	21509	7200	9391	15984	17332	9333	12086	15872	19046
15. Hydrocarbon (ppm) uncor/cor	1250	1364	—		1250	1355	—		—	
16. Sulfur Dioxide (ppm) uncor/cor	360	393	—		420	455	—		—	
17. Smoke Spot (Bacharach)	—		—		—					
18. Atmos. Temp. (°F/°C)	76		76		70		70		70	
19. Dew Point Temp. (°F/°C)	67		67		66		66		66	
20. Atmos. Pressure (in. Hg)	29.80		29.80		29.81		29.81		29.81	
21. Relative Humidity (%)	64		64		82		82		82	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 10/2-14

Test No. 10/2-14 Date 9-23-76 Location 10 Engr. WOOD

Unit No. 2 Fuel BLK. LIQ. Capacity

Unit Type RECOVERY-BLK. LIQ. BOILER Burner Type

1. Test No.	10/2-14		10/2-14		10/2-14		10/2-14		10/2-14	
2. Date	9-23-76		9-23-76		9-23-76		9-23-76		9-23-76	
3. Time	1250		1305		1320		1410		1415	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	ESP IN		ESP OUT		COMP.		ESP IN		ESP OUT	
8. Oxygen (%)	4.7		7.0		6.0		4.3		7.0	
9. NOx (hot) read/3% O_2 (ppm)	20	22	—		—		20	22	—	
10. NO (hot) read/3% O_2 (ppm)	18	20	—		—		19	20	—	
11. NO_2 (hot) read/3% O_2 (ppm)	2	2	—		—		1	1	—	
12. NO (cold) read/3% O_2 (ppm)	26	29	22	28	22	26	32	34	28	36
13. Carbon Dioxide (%)	14.2		12.0		12.8		14.8		12.8	
14. Carbon Monoxide (ppm) uncor/cor	24298	26832	21221	27258	27840	33408	21460	23131	21057	27074
15. Hydrocarbon (ppm) uncor/cor	1500	1656	—		—		1750		—	
16. Sulfur Dioxide (ppm) uncor/cor	500	552	—		—		600		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	82		82		82		84		84	
19. Dew Point Temp. (°F/°C)	72		72		72		73		73	
20. Atmos. Pressure (in. Hg)	29.92		29.92		29.92		29.89		29.89	
21. Relative Humidity (%)	62		62		62		60		60	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 10/2-14

Test No. 10/2-14 Date 9-23-76 Location 10 Engr. WOOD

Unit No. 2 Fuel BLK. LIQ. Capacity

Unit Type RECOVERY / BLK. LIQ. BOIL. Burner Type

1. Test No.	10/2-14					
2. Date	9-23-76					
3. Time	1427					
4. Load						
5. Process Rate						
6. Flue Diam. or Size, ft						
7. Probe Position	TRAVERSE					
8. Oxygen (%)						
9. NOx (hot) read/3% O_2 (ppm)	—					
10. NO (hot) read/3% O_2 (ppm)	—					
11. NO_2 (hot) read/3% O_2 (ppm)	—					
12. NO (cold) read/3% O_2 (ppm)						
13. Carbon Dioxide (%)						
14. Carbon Monoxide (ppm) uncor/cor						
15. Hydrocarbon (ppm) uncor/cor	—					
16. Sulfur Dioxide (ppm) uncor/cor	—					
17. Smoke Spot (Bacharach)						
18. Atmos. Temp. (°F/°C)						
19. Dew Point Temp. (°F/°C)						
20. Atmos. Pressure (in. Hg)	29.89					
21. Relative Humidity (%)						
22.						
23.						
24.						
25.						
26.						
27.						
28.						
29.						
30.						

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 10/2-15

Test No. 10/2-15 Date 9-24-76 Location 10 Engr. WOOD

Unit No. 2 Fuel BLK. LIQ. Capacity

Unit Type RECOVERY / BLK. LIQ. BOILER Burner Type

1. Test No.	10/2-15	10/2-15	10/2-15	10/2-15	10/2-15
2. Date	9-24-76	9-24-76	9-24-76	9-24-76	9-24-76
3. Time	1440	1445	1459	1555	1605
4. Load					
5. Process Rate					
6. Flue Diam. or Size, ft					
7. Probe Position	COMPOSITE	ESP IN	ESP OUT	ESP IN	ESP OUT
8. Oxygen (%)	6.1	4.4	7.1	4.4	7.3
9. NOx (hot) read/3% O_2 (ppm)	—	27 29	—	24 26	—
10. NO (hot) read/3% O_2 (ppm)	—	26 28	—	23 25	—
11. NO_2 (hot) read/3% O_2 (ppm)	—	1 1	—	1 1	—
12. NO (cold) read/3% O_2 (ppm)	35 42	32 35	36 47	37 40	32 42
13. Carbon Dioxide (%)	13.8	15.0	13.2	14.8	12.4
14. Carbon Monoxide (ppm) uncor/cor	14076 17005	16765 18179	9240 11965	15725 17051	11573 15206
15. Hydrocarbon (ppm) uncor/cor	—	1050 1139	—	750 813	—
16. Sulfur Dioxide (ppm) uncor/cor	—	*	—	*	—
17. Smoke Spot (Bacharach)	—	—	—	—	—
18. Atmos. Temp. (°F/°C)	84	84	84	85	85
19. Dew Point Temp. (°F/°C)	70	70	70	71	71
20. Atmos. Pressure (in. Hg)	29.88	29.88	29.88	29.86	29.86
21. Relative Humidity (%)	50	50	50	51	51
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

* NO Flow On Sample Position

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 10/2-15, -16 Date 9-24-76, 9-27-76 Location ID Engr. WOOD

Unit No. 2 Fuel BLK. LIQ. Capacity

Unit Type RECOVERY/BLK. LQR. BOILER Burner Type

1. Test No.	10/2-15					10/2-16		10/2-16		10/2-16		
2. Date	9-24-76					9-27-76		9-27-76		9-27-76		
3. Time	1610					1100		1106		1116		
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	COMP.					ESP IN		ESP OUT		COMP.		
8. Oxygen (%)	6.5					4.9		7.2		6.3		
9. NOx (hot) read/3% O_2 (ppm)	—					24	27	—		—		
10. NO (hot) read/3% O_2 (ppm)	—					23	26	—		—		
11. NO_2 (hot) read/3% O_2 (ppm)	—					1	1	—		—		
12. NO (cold) read/3% O_2 (ppm)	34	42				36	40	29	38	29	36	
13. Carbon Dioxide (%)	12.8					14.0		12.0		12.8		
14. Carbon Monoxide (ppm) uncor/cor	1225	3934				13176	14731	13271	17309	12373	15151	
15. Hydrocarbon (ppm) uncor/cor	—					1250	1398	—		—		
16. Sulfur Dioxide (ppm) uncor/cor	—					N/A	—	—		—		
17. Smoke Spot (Bacharach)	—					—		—		—		
18. Atmos. Temp. (°F/°C)	85					81		81		81		
19. Dew Point Temp. (°F/°C)	71					76		76		76		
20. Atmos. Pressure (in. Hg)	29.86					29.80		29.80		29.80		
21. Relative Humidity (%)	51					80		80		80		
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 10/2-16

Test No. 10/2-16 Date 9-27-76 Location 10 Engr. WOOD

Unit No. 2 Fuel BLK. LQR. Capacity FULL

Unit Type RECOVERY/BLK. LQR. BOIL. Burner Type

1. Test No.	10/2-16		10/2-16		10/2-16		10/2-16		10/2-16	
2. Date	9-27-76		9-27-76		9-27-76		9-27-76		9-27-76	
3. Time	1445		1455		1500		1610		1620	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	ESP IN		ESP OUT		COMP.		ESP IN		ESP OUT	
8. Oxygen (%)	4.6		7.4		6.6		4.8		7.5	
9. NOx (hot) read/3% O_2 (ppm)	21	23	—		—		25	28	—	
10. NO (hot) read/3% O_2 (ppm)	19	21	—		—		24	27	—	
11. NO_2 (hot) read/3% O_2 (ppm)	2	2	—		—		1	1	—	
12. NO (cold) read/3% O_2 (ppm)	34	37	31	41	33	41	39	43	32	43
13. Carbon Dioxide (%)	14.4		11.7		12.3		14.8		11.3	
14. Carbon Monoxide (ppm) uncor/cor	16457	18063	12870	17034	14801	14350	15725	17472	10735	14313
15. Hydrocarbon (ppm) uncor/cor	1000	1098	—		—		1000	1111	—	
16. Sulfur Dioxide (ppm) uncor/cor	N.A.	—	—		—		N.A.	—	—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	84		84		84		85		85	
19. Dew Point Temp. (°F/°C)	76		76		76		77		77	
20. Atmos. Pressure (in. Hg)	29.73		29.73		29.73		29.70		29.70	
21. Relative Humidity (%)	70		70		70		70		70	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 10/2-16

Test No 10/2-16 Date 9-27-76 Location 10 Engr. WOOD

Unit No. 2 Fuel BLK. LQR. Capacity

Unit Type RECOVERY/BLK. LQR. BOIL. Burner Type

1. Test No.	10/2-16					
2. Date	9-27-76					
3. Time	1625					
4. Load						
5. Process Rate						
6. Flue Diam. or Size, ft						
7. Probe Position	COMP.					
8. Oxygen (%)	6.6					
9. NOx (hot) read/3% O_2 (ppm)	—					
10. NO (hot) read/3% O_2 (ppm)	—					
11. NO_2 (hot) read/3% O_2 (ppm)	—					
12. NO (cold) read/3% O_2 (ppm)	34 42					
13. Carbon Dioxide (%)	12.0					
14. Carbon Monoxide (ppm) uncor/cor	1050/1325					
15. Hydrocarbon (ppm) uncor/cor	—					
16. Sulfur Dioxide (ppm) uncor/cor	—					
17. Smoke Spot (Bacharach)	—					
18. Atmos. Temp. (°F/°C)	85					
19. Dew Point Temp. (°F/°C)	77					
20. Atmos. Pressure (in. Hg)	29.70					
21. Relative Humidity (%)	70					
22.						
23.						
24.						
25.						
26.						
27.						
28.						
29.						
30.						

Data Sheet 6002-2

OPERATING DATA

Location 10

Unit 2

Test No.	10/2-1			10/2-2			10/2-3					
Date	8-26-76			8-27-76			8-30-76					
Time	1050			1430			1600					
Steam Flow, lb/hr	178,000			195,000			185,000					
Steam Press., psig	850			850			860					
Final Steam Temp. Before Attemp., °F	—			—			—					
Final Steam Temp. After Attemp., °F	810			810			800					
Burner Gas Press., psig	0			0			0					
Black Liquor Solids, percent	65			65			65					
Main Dissolving Tank Density	1.135			1.14			1.13					
Percent O_2/Percent Combustibles	5.3-6.3	0.075		5.2	0.075		5.3	0.075				
Total Air Flow, percent	76			80			75					
Primary Air Flow, percent	39			40.5			38					
Black Liquor Flow to Burners, GPM	212			204			214					
Secondary Air Flow Damper pos. % open	70			60			55					
Gas Flow to Recov. Boiler, SCFH	0			0			0					
Black Liquor to Burner pressure, psig	20			18.3			18					
Black Liquor to Burner temp., °F	252			255			253					
F.W. Temp., °F (typical)	291			—			—					
Steam A.H. Air In, °F	105			106			98					
Steam A.H. Air Out, °F	~250			—			~250					
Boiler Gas Out, °F	770			780			788					
L.H. Cascade Evap. Gas Out, °F/R.H.	302	310		300	305		310	310				
East Econ. Gas Temp., °F/West Econ.	611	595		630	610		616	630				
L.H. Precip. Gas Out/R.H. Precip., °F	260	290		245	295		270	300				
Economizer Water Outlet, °F	390			410			402					
I.D. Fan Inlet Draft, in. H_2O	-3.2			-3.3			-3.6					
L.H./R.H. Precip. Out Draft, in. H_2O	-5.2	-5.2		-5.4	-5.3		-5.5	-5.5				
Economizer Out Draft, in. H_2O	-2.1			-2			-2.1					
Economizer In Draft, in. H_2O	-0.6			-0.5			-0.6					
Boiler Inlet Draft, in. H_2O	-0.5			-0.3			-0.3					
Furnace Draft, in. H_2O	-0.2			-0.4			-0.2					
Secondary Air Pressure, in. H_2O	5.8			5.5			5.2					
Primary Air Pressure, in. H_2O	3.0			3.0			3.4					
F.D. Fan Disch. Pressure, in. H_2O	8.0			8.0			8.0					
L.H./R.H./New Casc. Evap. Motor Load, %	51	54	39	52	55	45	50	60	44			
Black Liquor Burner In Service	6			6			6					
Comments:	Baseline, Condensation in hot line			Baseline, Particulate test			Baseline, SO_x					

OPERATING DATA

Location 10

Unit 2

Test No.	10/2-4	10/2-5	10/2-6	10/2-7
Date	8-31-76	8-31-76	8-31-76	9-1-76
Time	0930	1330	1630	0905
Steam Flow, lb/hr	200,000	195,000	175,000	185,000
Steam Press., psig	860	860	850	850
Final Steam Temp. Before Attemp., °F	—	—	—	—
Final Steam Temp. After Attemp., °F	810	815	825	800
Burner Gas Press., psig	0	0	17.5	16.5
Black Liquor Solids, percent	65	64	63	63
Main Dissolving Tank Density	1.055	1.135	1.15	1.16
Percent O_2/Percent Combustibles	3.7 | 0.075	3.6 | 0.075	3.4 | 0.075	5.4 | 0.075
Total Air Flow, percent	79	80	79.5	77
Primary Air Flow, percent	42	42	44.5	39
Black Liquor Flow to Burners, GPM	210	212	226	220
Secondary Air Flow Damper pos. % open	80	100	46	100
Gas Flow to Recov. Boiler, SCFH	0	0	0	50,000
Black Liquor to Burner pressure, psig	15	16.2	17.4	16.5
Black Liquor to Burner temp., °F	252	252	253	252
F.W. Temp., °F (typical)	—	—	—	—
Steam A.H. Air In, °F	90	95	100	95
Steam A.H. Air Out, °F	~250	~250	245	245
Boiler Gas Out, °F	820	825	810	795
L.H. Cascade Evap. Gas Out, °F/R.H.	308 | 310	310 | 310	308 | 310	320 | 320
East Econ. Gas Temp., °F/West Econ.	650 | 600	627 | 625	640 | 590	620 | 635
L.H. Precip. Gas Out/R.H. Precip., °F	270 | 290	278 | 295	272 | 295	280 | 310
Economizer Water Outlet, °F	412	415	420	395
I.D. Fan Inlet Draft, in. H_2O	-4.0	-4.0	-4.0	-3.6
L.H./R.H. Precip. Out Draft, in. H_2O	-6 | -6	-6.2 | -6.2	-6.0 | -6.0	-5.5 | -5.5
Economizer Out Draft, in. H_2O	-2.4	-2.5	-2.5	-2.2
Economizer In Draft, in. H_2O	-0.6	-0.6	-0.5	-0.6
Boiler Inlet Draft, in. H_2O	-0.3	-0.3	-0.3	-0.4
Furnace Draft, in. H_2O	-0.2	-0.2	-0.3	-0.3
Secondary Air Pressure, in. H_2O	6	6	5.0	6.2
Primary Air Pressure, in. H_2O	4.2	4	3.8	3.4
F.D. Fan Disch. Pressure, in. H_2O	8	8	8.0	8.0
L.H./R.H./New Casc. Evap. Motor Load, %	60 | 70 | 46	55 | 62 | 46	54 | 60 | 41	49 | 49 | 35
Black Liquor Burner In Service	7	7	7	7
Comments:	Baseline	Sec. Air-damper 100% open, SO_x	Sec. Air-damper 46% open	Baseline, with gas

OPERATING DATA

Location 10

Unit 2

Test No.	10/2-8			10/2-9								
Date	9-1-76			9-1-76								
Time	1010			1115								
Steam Flow, lb/hr	200,000			195,000								
Steam Press., psig	860			860								
Final Steam Temp. Before Attemp., °F	—			—								
Final Steam Temp. After Attemp., °F	803			816								
Burner Gas Press., psig	16.7			15								
Black Liquor Solids, percent	60			60								
Main Dissolving Tank Density	1.15			1.155								
Percent O_2/Percent Combustibles	3.2	0.075		5.4	0.075							
Total Air Flow, percent	73			75								
Primary Air Flow, percent	37			38								
Black Liquor Flow to Burners, GPM	204			204								
Secondary Air Flow Damper pos. % open	100			79								
Gas Flow to Recov. Boiler, SCFH	50,000			50,000								
Black Liquor to Burner pressure, psig	15.7			15.7								
Black Liquor to Burner temp., °F	252			251								
F.W. Temp., °F (typical)	—			—								
Steam A.H. Air In, °F	100			101								
Steam A.H. Air Out, °F	245			245								
Boiler Gas Out, °F	775			790								
L.H. Cascade Evap. Gas Out, °F/R.H.	310	315		318	318							
East Econ. Gas Temp., °F/West Econ.	610	610		608	635							
L.H. Precip. Gas Out/R.H. Precip., °F	272	310		265	310							
Economizer Water Outlet, °F	420			405								
I.D. Fan Inlet Draft, in. H_2O	-3.3			-3.3								
L.H./R.H. Precip. Out Draft, in. H_2O	-5.0	-5.2		-5.0	-5.0							
Economizer Out Draft, in. H_2O	-2.0			-2.1								
Economizer In Draft, in. H_2O	-0.6			-0.5								
Boiler Inlet Draft, in. H_2O	-0.4			-0.25								
Furnace Draft, in. H_2O	-0.2			-0.1								
Secondary Air Pressure, in. H_2O	6.2			6.1								
Primary Air Pressure, in. H_2O	3.6			3.2								
F.D. Fan Disch. Pressure, in. H_2O	8.0			8.0								
L.H./R.H./New Casc. Evap. Motor Load, %	50	55	45	49	52	45						
Black Liquor Burner In Service	6			6								
Comments:	Baseline, low solids			Baseline, low solids, SO_x								

OPERATING DATA

Location 10

Unit 2

Test No.	10/2-10	10/2-10	10/2-10
Date	9-15-76	9-15-76	9-15-76
Time	1215	1345	1500
Steam Flow, lb/hr	198-204,000	233,000	204,000
Steam Press., psig	840	840	840
Final Steam Temp. Before Attemp., °F	870	845	880
Final Steam Temp. After Attemp., °F	—	—	815
Burner Gas Press., psig	0	0	0
Black Liquor Solids, percent	65	65	65
Main Dissolving Tank Density	1.185	1.185	1.186
Percent O_2/Percent Combustibles	5.3 | 0.005	4.8 | 0.005	5.1 | 0.005
Total Air Flow, percent	69.5	73.5	73.5
Primary Air Flow, percent	39.5	40.8	40.2
Black Liquor Flow to Burners, GPM	204	204	204
Secondary Air Flow Damper pos. % open	50	50	50
Gas Flow to Recov. Boiler, SCFM	0	0	0
Black Liquor to Burner pressure, psig	16	16.2	16.2
Black Liquor to Burner temp., °F	250	250	250
F.W. Temp., °F (typical)	—	—	—
Steam A.H. Air In, °F	100	105	105
Steam A.H. Air Out, °F	600	645	645
Boiler Gas Out, °F	790	780	780
L.H. Cascade Evap. Gas Out, °F/R.H.	305 | 300	300 | 300	300 | 300
East Econ. Gas Temp., °F/West Econ.	605 | 645	620 | 620	610 | 640
L.H. Precip. Gas Out/R.H. Precip., °F	300 | 290	260 | 290	260 | 290
Economizer Water Outlet, °F	410	400	400
I.D. Fan Inlet Draft, in. H_2O	-2.9	-2.6	-2.8
L.H./R.H. Precip. Out Draft, in. H_2O	-5.3 | -5.3	-5.0 | -4.8	-5.3 | -5.3
Economizer Out Draft, in. H_2O	-2.1	-2.1	-2.1
Economizer In Draft, in. H_2O	-0.6	-0.6	-0.6
Boiler Inlet Draft, in. H_2O	-0.2	-0.3	-0.3
Furnace Draft, in. H_2O	-0.25	-0.2	-0.2
Secondary Air Pressure, in. H_2O	5.3	5.2	5.2
Primary Air Pressure, in. H_2O	3.0	3.0	3.2
F.D. Fan Disch. Pressure, in. H_2O	8.5	8.0	8.0
L.H./R.H./New Casc. Evap. Motor Load, %	50 | 55 | 40	53 | 57 | 40	52 | 60 | 40
Black Liquor Burner In Service	7	7	7

Comments: Trace element test at inlet to contact evaporator

OPERATING DATA

Location 10

Unit 2

Test No.	10/2-12	10/2-12	10/2-12
Date	9-16-76	9-16-76	9-16-76
Time	1340	1420	1520
Steam Flow, lb/hr	233,000	181,000	163,000
Steam Press., psig	840	840	840
Final Steam Temp. Before Attemp., °F	860	830	800
Final Steam Temp. After Attemp., °F	787	780	755
Burner Gas Press., psig	18	18	18
Black Liquor Solids, percent	68.5	68.5	69
Main Dissolving Tank Density	—	—	—
Percent O_2/Percent Combustibles	4.2 | 0.05	6.2 | 0.05	7.1 | 0.05
Total Air Flow, percent	70	65.5	72
Primary Air Flow, percent	42	39.5	42
Black Liquor Flow to Burners, GPM	164	120	120
Secondary Air Flow Damper pos. % open	50	50	50
Gas Flow to Recov. Boiler, SCFH	0	0	0
Black Liquor to Burner pressure, psig	16.2	20	21
Black Liquor to Burner temp., °F	250	250	250
F.W. Temp., °F (typical)	—	—	—
Steam A.H. Air In, °F	110	115	115
Steam A.H. Air Out, °F	Not Working	Not Working	Not Working
Boiler Gas Out, °F	800	775	750
L.H. Cascade Evap. Gas Out, °F/R.H.	300 | 300	295 | 295	280 | 280
East Econ. Gas Temp., °F/West Econ.	620 | 600	600 | 575	575 | 555
L.H. Precip. Gas Out/R.H. Precip., °F	245 | 290	240 | 285	230 | 275
Economizer Water Outlet, °F	400	385	410
I.D. Fan Inlet Draft, in. H_2O	-2.4	-2.1	-2.2
L.H./R.H. Precip. Out Draft, in. H_2O	-4.6 | -4.5	-4.2 | -4.2	-4.3 | -4.2
Economizer Out Draft, in. H_2O	-2.2	-1.7	-1.9
Economizer In Draft, in. H_2O	-0.65	-0.5	-0.6
Boiler Inlet Draft, in. H_2O	-0.3	-0.3	-0.55
Furnace Draft, in. H_2O	-0.3	-0.3	~ -0.5
Secondary Air Pressure, in. H_2O	6.0	5.5	5.8
Primary Air Pressure, in. H_2O	3.5	3.8	3.6
F.D. Fan Disch. Pressure, in. H_2O	8.0	8.0	8.0
L.H./R.H./New Casc. Evap. Motor Load, %	55 | 60 | 40	55 | 60 | 40	60 | 70 | 40
Black Liquor Burner In Service	6	4	4

Comments: Trace element test at inlet to contact evaporator

OPERATING DATA

Location 10

Unit 2

Test No.	10/2-14	10/2-14	10/2-14	10/2-14
Date	9-22-76	9-22-76	9-22-76	9-23-76
Time	1653	1850	1952	1221
Steam Flow, lb/hr	239,000	227,000	210,000	204,000
Steam Press., psig	860	850	860	840
Final Steam Temp. Before Attemp., °F	880	850	860	880
Final Steam Temp. After Attemp., °F	825	790	815	815
Burner Gas Press., psig	0	0	0	0
Black Liquor Solids, percent	62	63	63.5	60
Main Dissolving Tank Density	1.180	1.165	1.163	1.168
Percent O_2/Percent Combustibles	3.85 | 0.005	3.2 | 0.005	3.5 | 0.05	3.6 | 0.05
Total Air Flow, percent	74.5	72.5	73	65
Primary Air Flow, percent	42	41	41	39.5
Black Liquor Flow to Burners, GPM	165	201	210	213
Secondary Air Flow Damper pos. % open	60	60	60	50
Gas Flow to Recov. Boiler, SCFH	0	0	0	0
Black Liquor to Burner pressure, psig	18	15	15	15
Black Liquor to Burner temp., °F	253	253	253	250
F.W. Temp., °F (typical)	—	—	—	—
Steam A.H. Air In, °F	100	100	100	100
Steam A.H. Air Out, °F	Not Working	Not Working	Not Working	440
Boiler Gas Out, °F	790	790	790	780
L.H. Cascade Evap. Gas Out, °F/R.H.	320 | 320	320 | 315	320 | 320	320 | 320
East Econ. Gas Temp., °F/West Econ.	640 | 640	625 | 630	630 | 650	620 | 635
L.H. Precip. Gas Out/R.H. Precip., °F	275 | 300	280 | 300	280 | 300	280 | 300
Economizer Water Outlet, °F	400	400	410	415
I.D. Fan Inlet Draft, in. H_2O	-2.8	-3.0	-3.0	-2.9
L.H./R.H. Precip. Out Draft, in. H_2O	-5.0 | -5.0	-5.3 | -5.3	-5.3 | -5.1	-5.0 | -5.0
Economizer Out Draft, in. H_2O	-2.2	-2.1	-2.0	-2.0
Economizer In Draft, in. H_2O	-0.6	-0.6	-0.5	-0.5
Boiler Inlet Draft, in. H_2O	-0.4	-0.4	-0.5	-0.4
Furnace Draft, in. H_2O	-0.3	-0.3	-0.3	-0.3
Secondary Air Pressure, in. H_2O	6.0	6.0	6.0	5.7
Primary Air Pressure, in. H_2O	2.7	2.7	3.0	2.5
F.D. Fan Disch. Pressure, in. H_2O	8.5	8.0	8.0	8.0
L.H./R.H./New Casc. Evap. Motor Load, %	50 | 55 | 40	50 | 55 | 40	50 | 50 | 40	50 | 50 | 40
Black Liquor Burner In Service	6	6	6	7

Comments: Trace element test at ESP outlet

OPERATING DATA

Location 10

Unit 2

Test No.	10/2-14			
Date	9-23-76			
Time	1400			
Steam Flow, lb/hr	169,000			
Steam Press., psig	840			
Final Steam Temp. Before Attemp., °F	850			
Final Steam Temp. After Attemp., °F	790			
Burner Gas Press., psig	0			
Black Liquor Solids, percent	60			
Main Dissolving Tank Density	1.166			
Percent O_2/Percent Combustibles	3.7 / 0.05			
Total Air Flow, percent	61			
Primary Air Flow, percent	37			
Black Liquor Flow to Burners, GPM	204			
Secondary Air Flow Damper pos. % open	50			
Gas Flow to Recov. Boiler, SCFH	0			
Black Liquor to Burner pressure, psig	15			
Black Liquor to Burner temp., °F	250			
F.W. Temp., °F (typical)	—			
Steam A.H. Air In, °F	100			
Steam A.H. Air Out, °F	Not Working			
Boiler Gas Out, °F	755			
L.H. Cascade Evap. Gas Out, °F/R.H.	315 / 315			
East Econ. Gas Temp., °F/West Econ.	600 / 620			
L.H. Precip. Gas Out/R.H. Precip., °F	280 / 300			
Economizer Water Outlet, °F	415			
I.D. Fan Inlet Draft, in. H_2O	-2.6			
L.H./R.H. Precip. Out Draft, in. H_2O	-4.5 / -4.5			
Economizer Out Draft, in. H_2O	-2.0			
Economizer In Draft, in. H_2O	-0.55			
Boiler Inlet Draft, in. H_2O	-0.2			
Furnace Draft, in. H_2O	-0.2			
Secondary Air Pressure, in. H_2O	6.0			
Primary Air Pressure, in. H_2O	3.0			
F.D. Fan Disch. Pressure, in. H_2O	8.0			
L.H./R.H./New Casc. Evap. Motor Load, %	50 / 50 / 40			
Black Liquor Burner In Service	7			

Comments: Trace element test at ESP outlet (concluded)

OPERATING DATA

Location 10

Unit 2

Test No.	10/2-15	10/2-15	10/2-15	10/2-15
Date	9-24-76	9-24-76	9-24-76	9-24-76
Time	1037	1424	1505	1554
Steam Flow, lb/hr	199,000	215,000	223,000	215,000
Steam Press., psig	860	850	860	850
Final Steam Temp. Before Attemp., °F	—	880	875	850
Final Steam Temp. After Attemp., °F	—	810	815	790
Burner Gas Press., psig	0	0	0	0
Black Liquor Solids, percent	64	67	67	67
Main Dissolving Tank Density	1.17	1.142	1.148	1.150
Percent O_2/Percent Combustibles	3.2 | 0.05	2.6 | 0.05	2.95 | 0.05	2.4 | 0.05
Total Air Flow, percent	69	74.5	75	73.5
Primary Air Flow, percent	42	42	43	42
Black Liquor Flow to Burners, GPM	182	192	190	190
Secondary Air Flow Damper pos. % open	65	60	60	60
Gas Flow to Recov. Boiler, SCFH	0	0	0	0
Black Liquor to Burner pressure, psig	18	17	17	16
Black Liquor to Burner temp., °F	260	253	253	252
F.W. Temp., °F (typical)	—	—	—	—
Steam A.H. Air In, °F	100	110	100	110
Steam A.H. Air Out, °F	Not Working	Not Working	255	260
Boiler Gas Out, °F	795	800	795	780
L.H. Cascade Evap. Gas Out, °F/R.H.	310 | 310	320 | 320	320 | 315	310 | 315
East Econ. Gas Temp., °F/West Econ.	620 | 580	640 | 600	630 | 590	635 | 580
L.H. Precip. Gas Out/R.H. Precip., °F	280 | 290	265 | 300	265 | 300	260 | 300
Economizer Water Outlet, °F	395	410	400	415
I.D. Fan Inlet Draft, in. H_2O	-2.8	-3.2	-3.0	-3.0
L.H./R.H. Precip. Out Draft, in. H_2O	-5.0 | -4.8	-5.4 | -5.4	-5.3 | -5.3	-5.1 | -5.0
Economizer Out Draft, in. H_2O	-2.2	-2.3	-2.3	-2.1
Economizer In Draft, in. H_2O	-0.75	-0.6	-0.6	-0.6
Boiler Inlet Draft, in. H_2O	-0.5	-0.3	-0.5	-0.3
Furnace Draft, in. H_2O	-0.4	-0.2	-0.3	-0.3
Secondary Air Pressure, in. H_2O	6.5	6.0	6.0	6.0
Primary Air Pressure, in. H_2O	3.5	3.5	3.3	3.1
F.D. Fan Disch. Pressure, in. H_2O	8.5	8.0	8.0	8.0
L.H./R.H./New Casc. Evap. Motor Load, %	50 | 55 | 42	50 | 55 | 40	— | — | —	50 | 55 | 40
Black Liquor Burner In Service	6	7	7	7

Comments:

OPERATING DATA

Location 10

Unit 2

Test No.	10/2-16			10/2-16			10/2-16					
Date	9-27-76			9-27-76			9-27-76					
Time	1229			1401			1550					
Steam Flow, lb/hr	227,000			233,000			215,000					
Steam Press., psig	850			860			855					
Final Steam Temp. Before Attemp., °F	885			860			890					
Final Steam Temp. After Attemp., °F	820			823			820					
Burner Gas Press., psig	0			0			0					
Black Liquor Solids, percent	64			65			66					
Main Dissolving Tank Density	1.18			1.161			1.162					
Percent O_2/Percent Combustibles	3.0	0.05		2.4	0.05		2.3	0.05				
Total Air Flow, percent	69			70			69					
Primary Air Flow, percent	41			40			40					
Black Liquor Flow to Burners, GPM	180			180			180					
Secondary Air Flow Damper pos. % open	65			65			65					
Gas Flow to Recov. Boiler, SCFH	0			0			0					
Black Liquor to Burner pressure, psig	18			18			18					
Black Liquor to Burner temp., °F	255			255			255					
F.W. Temp., °F (typical)	—			—			—					
Steam A.H. Air In, °F	100			100			100					
Steam A.H. Air Out, °F	255			260			255					
Boiler Gas Out, °F	810			795			785					
L.H. Cascade Evap. Gas Out, °F/R.H.	315	315		310	310		300	300				
East Econ. Gas Temp., °F/West Econ.	625	600		615	585		620	570				
L.H. Precip. Gas Out/R.H. Precip., °F	270	295		270	290		270	295				
Economizer Water Outlet, °F	410			420			410					
I.D. Fan Inlet Draft, in. H_2O	-3.0			-2.8			-3.0					
L.H./R.H. Precip. Out Draft, in. H_2O	-5.2	-5.2		-5.0	-5.0		-5.0	-5.0				
Economizer Out Draft, in. H_2O	-2.3			-2.1			-2.3					
Economizer In Draft, in. H_2O	-0.6			-0.5			-0.6					
Boiler Inlet Draft, in. H_2O	-0.4			-0.3			-0.5					
Furnace Draft, in. H_2O	-0.3			-0.3			-0.4					
Secondary Air Pressure, in. H_2O	6.0			6.2			6.2					
Primary Air Pressure, in. H_2O	3.7			3.7			3.6					
F.D. Fan Disch. Pressure, in. H_2O	8.3			8.3			8.0					
L.H./R.H./New Casc. Evap. Motor Load, %	50	55	40	55	55	40	53	54	42			
Black Liquor Burner In Service	6			6			6					

Comments: Trace element test at ESP outlet.
Unit running without saltcake makeup since 0500 hrs.

LOCATION 10

UNIT 2

FUEL (BLACK LIQUOR) ANALYSIS

st 10/2-2 August 31, 1976

Organically Combined Elements	
Carbon	21.07 % by weight
Hydrogen	2.38
Sulfur	0.19
Nitrogen	0.04
Oxygen (by difference)	16.16
Sodium	7.13
Inorganic Constituents	
Sodium Carbonate (Na_2CO_3)	5.62
Sodium Sulfate (Na_2SO_4)	10.66
Sodium Chloride (NaCl)*	1.25
Sodium Hydroxide (NaOH)	not present
Sodium Sulfide (Na_2S)	not present
Moisture (H_2O)*	35.5

*determination not requested, but required for constituent balance

Gross Heat of combustion, BTU/lb 4117

The sodium listed under organically combined elements is probably present as the salt of organic acids. This sodium was calculated by subtracting the inorganic salt sodium from the total sodium.

LOCATION 10

UNIT 2

FUEL AND SMELT ANALYSES

	Black Liquor	Black Liquor	Smelt 9/15/76	
Carbon, %	23.65	23.80		
Hydrogen, %	2.36	2.55		
Sulfur, %	2.44	1.84		
Sodium, %	11.56	8.56		
Nitrogen, %	0.06	0.06		
Oxygen, %	8.43	15.49		
Total	48.50	52.30		
Gross heat of combustion, Btu/lb	3911	4133		
Inorganic constituents				
Na_2CO_3, %	14.9	13.6	67.68	88.40
NaOH, %	--	--	21.44	N.D.
Na_2SO_4, %	4.26	4.36	1.68	0.98
Na_2S, %	N.D.	N.D.	N.D.	N.D.
NaSH, %	--	--	1.13	8.05
NaCl, %	1.01	1.09	2.55	2.57
Moisture, %	31.33	28.65	5.52	N.D.
Total	51.50	47.70	100.00	100.00

N.D. = not detected

PARTICULATE EMISSION CALCULATIONS

Test No. 10/2-1 Date 8-27-76 Location 10 Engr. Buening

Unit No. 2 Fuel BIK. Liq. Sampling Train and Method Modified Method 5

Pitot Factor, Fs 0.84 Barometric Pressure, P_{bar} 29.85 in. Hg

Tot. Liquid Collected, V_{lc} 215.97 ml Total Particulate, M_n 7529.2 m gm

Velocity Head, ΔP 0.075 iwg Stack Temp., Ts 1013 °R Stack Area, As 83.75 ft^2

Sample Volume, Vm 28.21 ft^3 Stack Press., Psg −2.1 iwg Excess O_2, XO_2% 3.8 %

Orifice Press. Diff., H 0.35 iwg Stack Gas Sp. Gravity, Gs 1.01 n.d. estimate

Sample Time, θ 75 min Nozzle Dia., Dn 0.375 in. Meter Temp., T_m — °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	28.149	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	10.24	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	0.2667	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	4.119	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	0.00059	lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	9.45	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	403.86	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	1272.6	ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	55332	WSCF/min
	b. Qsd = Eq. 7a x (1. − Eq. 3)	40575	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	1436	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	122.22	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	8.23	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	3541	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	100.99	%

	Oil	Gas	Coal	Black Liquor
Fe SC Feet/10^4 Btu	92.2	87.4	98.2	114.20
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636	0.003065

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS

Test No. 10/2-1 Date 8-27-76 Location 10 Engr. 10/2-1

Unit No. 2 Fuel Blk. Liq. Sampling Train and Method Method 5

Pitot Factor, Fs 0.84 Barometric Pressure, P_{bar} 29.85 in. Hg

Tot. Liquid Collected, V_{lc} 215.97 ml Total Particulate, M_n 7449.3 m gm

Velocity Head, ΔP 0.075 iwg Stack Temp., Ts 1013 °R Stack Area, As 83.75 ft^2

Sample Volume, Vm 28.21 ft^3 Stack Press., Psg −2.1 iwg Excess O_2, XO_2 % 3.8 %

Orifice Press. Diff., H 0.35 iwg Stack Gas Sp. Gravity, Gs 1.01 n.d. estimated

Sample Time, θ 75 min Nozzle Dia., Dn 0.375 in. Meter Temp., T_m — °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	28.149	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	10.24	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	0.2667	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	4.075	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	0.00058	lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	9.35	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	403.86	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	1272.6	ft/min
7. Stack Gas Flow Rate @ 70°F	a. Qsw = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	55332	WSCF/min
	b. Qsd = Eq. 7a x (1. − Eq. 3)	40575	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	1412	lb/hr
9. XO_2 factor	$XO_2 f = 2090/(20.9 - XO_2\%)$	122.22	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	8.10	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	3481	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	100.99	%

	Oil	Gas	Coal	Black Liquor
Fe SC Feet/10^4 Btu	92.2	87.4	98.2	114.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636	0.003065

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE CALCULATION SHEET

Test Crew _____

Test No. 10/2-1 Date 8-27-76 Location 10

Box No. — Sample Probe Position —

Test Description Baseline

Dry Gas Meter Vol. (ft^3)

Final 1520.9

Initial 1492.69

Total 28.21

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final	340	64	—	682.40	
Initial	100	100	—	670.43	
Δ Vol	240	-36	—	11.97	215.97

Beaker No.	1	4	3		8	Filter No. 7	Blank No. 8
Date Weighed	8-26-76	8-26-76	8-26-76		8-26-76	8-17-76	8-17-76
Tare Wt. 1	100.0937	99.2629	101.9865		99.3343	0.8469	0.8557
2	100.0937	99.2630	101.9865		99.3345	0.8470	0.8557
3							
4							
5							
6							
Avg	100.0937	99.2630	101.9865		99.3344	0.8470	0.8557
Bottle No.	4 & 5	2 & 3	1				
Content	Impinger (Water)	Probe (Acetone)	Probe (Water)	~~Cyclone (Acetone)~~	Flask (Dry)		
Rinse (ml):	200 150 75 200	250 100 100 175 175 150	160 50				
Date Weighed or 250 Bake	8-31-76	9-1-76	9-1-76		8-31-76	8-31-76	8-31-76
Final Wt. 250 1	100.1601	100.4291	102.0004		99.6892	6.7745	0.8554
2	100.1602	100.4293	102.0002		99.6894	6.7748	0.8556
3					99.6897	6.7751	
4							
5							
6							
Avg	100.1602	100.4292	102.0003		99.6895	6.7748	0.8555
Residue wt Final 250-Tare	0.0665	1.1662	0.0138		0.3551	5.9278	-0.0002
Date Weighed or 650 Bake							
Final Wt. 650 1							
2							
3							
4							
5							
6							
Avg							
Residue Wt Final 650-Tare							

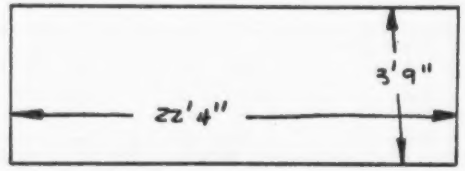
HYDROSCOPIC

Comments:

Data Sheet 6002-3

PLANT —
LOCATION 10
OPERATOR —
DATE 8-27-76
RUN NO. 10/2-1
SAMPLE BOX NO. 1
METER BOX NO. 1
METER H —
C FACTOR @ —

METHOD 5 CONTROL CONSOLE READINGS



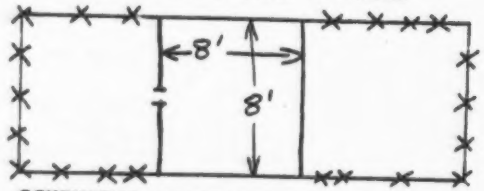
SCHEMATIC OF STACK CROSS SECTION

AMBIENT TEMPERATURE 84
BAROMETRIC PRESSURE 29.85
ASSUMED MOISTURE, % 15
HEATER BOX SETTING —
PROBE LENGTH, IN. 48
NOZZLE DIAMETER, IN. 3/8
PROBE HEATER SETTING —

Traverse Point Number	Sampling Time (θ) Min. Clock Time, Hrs.	Static Pressure (P_s), ~~In. Hg.~~ In. H_2O	Stack Temperature (T_s) °F	Velocity Head (P_s) In. H_2O	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
	1053	-2.1	540	0.075	0.35	1492.69		—	315	80
	1108	-2.1	560	0.075	0.35	1498.82		—	300	85
	1123	-2.1	545	0.075	0.35	1504.49		110	340	70
	1138	-2.1	560	0.075	0.35	1509.92		115	320	68
	1153	-2.1	570	0.075	0.35	1515.24		120	320	65
	1208	-2.1	540	0.075	0.35	1520.90		125	320	75
TOTAL			3315					AVG.	AVG.	
AVERAGE			553							

PLANT
LOCATION 10
OPERATOR
DATE 9-24-76
RUN NO. 10/2-15
SAMPLE BOX NO. —
METER BOX NO. 2
METER H
C FACTOR @

METHOD 5 CONTROL CONSOLE READINGS



SCHEMATIC OF STACK CROSS SECTION

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE
ASSUMED MOISTURE, %
HEATER BOX SETTING —
PROBE LENGTH, IN. 48
NOZZLE DIAMETER, IN. —
PROBE HEATER SETTING —

ANDERSEN IMPACTOR - ESP OUTLET

Traverse Point Number	Sampling Time (θ) Min. Clock Time, Hrs.	Static Pressure (P_s), In. Hg.	Stack Temperature (T_s) °F	Velocity Head (P_s) In. H_2O	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
	1425		300	1.5	0.95	5591.86		—	—	—
	1435		300	1.5	0.85	5600.00		—	—	—
	1445		300	1.5	0.90	5608.00		90	—	65
	1455		300	1.5	0.90	5616.50		92	—	62
	1505		300	1.5	0.90	5623.30		98	—	62
	1515		300	1.5	0.90	5631.50		100	—	60
	1525		300	1.5	0.90	5638.90		102	—	58
		Shut down for	20 min.		Adjust meter volume by 0.60 cf					
	1545		298	1.5	0.90	5639.50		100	—	58
	1555		298	1.5	0.90	5647.00		100	—	58
	1605		—	—	—	5654.46		—	—	—
TOTAL			2696							
AVERAGE			300					AVG.	AVG.	

9-24-76

ANDERSEN CASCADE IMPACTOR DATA

Test No. 10/2-15 Location 10 Owner —

Impactor No. 1 Nozzle Size 1/4" Filter No. —

Stack Temperature 300 °F Impactor Flow Rate _____ CFM

Plate	Tare (g)	Final (g)	Net (g)	%	Cum. %	ECD (μ)
1	27.3376	27.3532	0.0156	16.993	100.000	
2	28.4574	28.4693	0.0119	12.963	83.007	
3	29.2545	29.2628	0.0083	9.041	70.044	
4	22.0757	22.0822	0.0065	7.081	61.003	
5	17.8183	17.8279	0.0096	10.458	53.922	
6	17.9125	17.9373	0.0248	27.015	43.464	
7	17.9220	17.9338	0.0118	12.854	16.449	
8	28.4030	28.4048	0.0018	1.961	3.595	
Back Up Filter	21.7606	21.7621	0.0015	1.634	1.634	

Data Sheet 6002-5

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 8-27-76 _____

Location: 10 _____

Unit: 2 _____

Test: 10/2-2 Personnel: _____

Fuel: Black Liquor _____

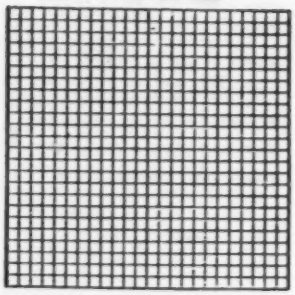
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): _____ (P_g)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
		½ Bowl	0.1					
		1 "	0.09					
		1½ "	0.08					
		2 "	0.05					
		2½ "	0.05					
		3 "	—					

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 9-15-76 _____

Location: 10 _____

Unit: 2 _____

Test: 10/2-10 Personnel: _____

Fuel: Black Liquor _____

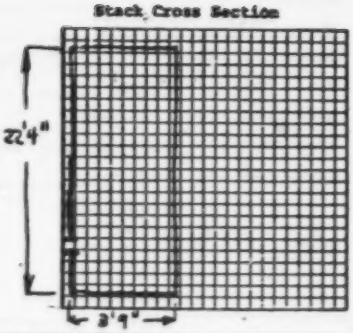
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): _____ (P_g)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth* Δt_i	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
		0.5	0.1	585				
		1.0	0.06	600				
		1.5	0.07	580				
		2.0	0.06	560			19.9	
		2.5	0.07	560				
		3.0	0.08	560				

* Measured from far wall

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 9-22-76

Location: 10

Unit: 2

Test: 10/2-14 Personnel: _____

Fuel: Black Liquor

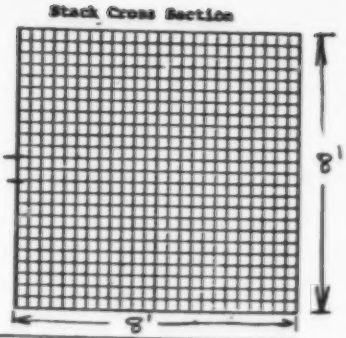
Barometric Press. (in. Hg): 29.87

Absolute Static Press. in Stack (in. Hg): 29.76 (P_g)

Pitot Tube Coefficient: 0.83 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth *	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
0920	2	1'	1.3	300				
—	2	2'1"	1.3	300				
—	2	3'2"	1.3	300				
—	2	4'3"	1.2	290	750	27.26	75	7.0
—	2	5'4"	1.1	290				
0940	2	6'5"	1.1	290				

* Measured from far wall

6003-13

Date 8-30-76 KVB, INC. Test No. 10/2-3

SOx DATA SHEET
Black

TEST NO. 10/2-3 UNIT NO. 2 FUEL Liquor LOAD 185 klb/hr 10 Location

Box No.	109	109	109		
Time	2:48	3:04	3:19		
Temp. in Gas Meter	92	90	90		
Press. in Gas Meter	0	-	0		
Meter Reading	0.00	1.100	2.006		
Barom. Press.	29.98				
Percent Oxygen	5.1	5.1	5.1		
N_2 Purge Time				3:24	3:44

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V (P + p)}$

Excess O_2 5.1 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	5.36	19.3	
B = Ml of lead perchlorate used for bland =	4.60	4.6	
N = Normality of lead perchlorate titrant =	0.01878	0.01878	
F = Dilution factor =	10.	0.0	
T = Average temp. in gas meter =	90	90	
V = Volume of gas sample ft^3 =	2.006	-	
P = Barometric pressure =	29.98	-	
p = Pressure in gas meter =	0	-	
Concentration, C, ppm =	31.9	61.7	
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm
F, volume factor = _____ $dscm/10^4$ cal

_____ $dscf/10^4$ Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 8-31-76 K V B, INC. Test No. 10/2-5

SOx DATA SHEET

TEST NO 10/2-5 UNIT NO. 2 FUEL Black Liquor LOAD 195 klb/hr ID Location

Box No.	309	309	306	306	
Time	2:16	2:52	3:17	4:05	
Temp. in Gas Meter	86	86	86	86	
Press. in Gas Meter	-	-	-	-	
Meter Reading	0.000	2.026	0.000	2.000	
Barom. Press.	29.88	-	29.88	-	
Percent Oxygen	3.4	-	3.7	-	
N_2 Purge Time	-	-	-	-	

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V (P + p)}$

Excess O_2 _____ %

Note: Leak in Box No. 309

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	4.8	10.4	
B = Ml of lead perchlorate used for bland =	-	4.6	
N = Normality of lead perchlorate titrant =	0.01878	0.01878	
F = Dilution factor =	10	0.	
T = Average temp. in gas meter =	86	86	
V = Volume of gas sample ft^3 =	—	2.000	
P = Barometric pressure =	29.88	—	
p = Pressure in gas meter =	0	—	
Concentration, C, ppm =	4.1	23.88	
, ym/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$ where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 9-1-76 KVB, INC. Test No. 10/2-9

SOx DATA SHEET

TEST NO. 10/2-9 UNIT NO. 2 FUEL Black Liq. LOAD — klb/hr 10 Location

Box No.	06	06			
Time	1310	1350			
Temp. in Gas Meter	94	95			
Press. in Gas Meter	0	0			
Meter Reading	0	2.362			
Barom. Press.	29.84	—			
Percent Oxygen	5.3	5.3			
N_2 Purge Time	—	—			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V (P + p)}$

Excess O_2 _____%

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	7.4	3.3	
B = Ml of lead perchlorate used for bland =	5.4	—	
N = Normality of lead perchlorate titrant =	0.01887	—	
F = Dilution factor =	10	10	
T = Average temp. in gas meter =	94.5	94.5	
V = Volume of gas sample ft^3 =	2.362	—	
P = Barometric pressure =	29.84	—	
p = Pressure in gas meter =	0	—	
Concentration, C, ppm =	71.25	117.57	
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - xO_2}\right]$ where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

TABLE TRACE SPECIES AND ORGANICS SAMPLING CONDITIONS
LOCATION 10 - BLACK LIQUOR RECOVERY BOILER

TS & O Run No.	1	2	3	4
Test Number	10/2-10	10/2-12	10/2-14	10/2-16
Date	9/15/76	9/16/76	9/22-23/76	9/27/76
Port Location	Furn. outlet	Furn. outlet	ESP outlet	ESP outlet
Velocity, m/s (f/s)	5.49 (18.00)	7.70 (25.24)	24.10 (79.06)	22.87 (75.00)
Stack Temp., K (°F)	555 (539)	546 (523)	411 (279)	407 (273)
Oxygen Content, % dry	4.7	7.8	7.5	7.45
Moisture, %	25.11	20.99	34.79	31.15
Sample Time, min.	38.6	25.8	300	301
Cyclone Flow, awcmm (awcfm)	0.081 (2.852)	0.115 (4.064)	0.120 (4.224)	0.115 (4.049)
Isokinetic Rate, %	113.6	91.9	97.4	97.7
Oven Temperature, K (°F)	478 (400)	478 (400)	478 (400)	478 (400)
XAD2 Temperature, K (°F)	306 (91)	307 (93)	321 (119)	296 (73)
Meter Temperature, K (°F)	308 (95)	313 (104)	307 (92)	305 (89)
Nozzle Size, mm (in.)	19 (0.75)	19 (0.75)	9.53 (0.375)	9.53 (0.325)
No. Filters Used	2	2	1	1
Sample Flow, dry, scmm (scfm)	0.0424(1.497)	0.0516(1.819)	0.0466(1.644)	0.0472(1.666)
Volume Collected, dry, scm(scf)	1.636(57.74)	1.330(46.92)	13.977(493.2)	14.213(501.5)
Particulate Catch, g	17.7646	8.4520	0.4928	0.4334
Solid Particulate, ng/J (lb/10^6 Btu)	4294 (9.99)	3180 (7.2)	16.8 (0.039)	14.5 (0.034)

TABLE BLACK LIQUOR RECOVERY BOILER PROCESS FLOW RATES FOR SASS TESTS

Test	10/2-10	10/2-12	10/2-14	10/2-16
Sample Position	Furn. outlet	Furn. outlet	ESP outlet	ESP outlet
Liquor Vol. Flow, m^3/s	0.0129	0.00852	0.0124	0.0114
(GPM)	204	135	197	180
Liquor Spec. Gravity	1.18	1.17	1.169	1.168
Liquor Mass Flow, g/s	15,185	9,964	14,528	13,263
Sodium in Liquor, %	19.8	19.8	16.3	16.3
Sodium Input, g/s	3,007	1,973	2,368	2,162
95% Smelt Na Output, g/s	2,856	1,874	2,250	2,054
Sodium in Smelt, %	43.7	43.7	42.9	42.9
Smelt Mass Flow, g/s	6,536	4,289	5,244	4,787
Liquor Heat Input, MW	138	90.5	140	127
(10^6 Btu/hr)	(471)	(309)	(477)	(435)
Excess O_2, %	4.7	7.8	7.5	7.45
Stack Flow, Nm^3/s, dry*	54.6	44.3	66.8	60.7
(dscfm)	115,700	93,831	141,600	128,700

*stack flow based on 3.065×10^{-7} dNm^3/J (11420 DSCF/10^6 Btu) at zero excess oxygen

KVB, Inc. Trace Species and Organics Sampling Data

Project: _____
Date: 9-15-76
Location: 10
Unit: Black Liquor Rec. Boiler
Test: 10/2-10
Fuel: Black Liquor

Personnel: McElroy, Thompson, Wood, Weise, Pionessa, Fields, Churry
Barometric Press: 29.90
Probe Nozzle Diameter (inches): — (Dn)
Absolute Static Press. in Stack ~~(in. Hg)~~: -1" H_2O (Ps)
Pitot Tube Coefficient: 0.85 (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In/Out		
1315	0	1½ ft ℄	0.04	2.0	402.420	6.7	—	—	90	68	360	91	91	-
1325	10	"	0.05	1.3	420.68	14.0	544	408	95	74	386	94	91	-
—	17.5	"	0.05	1.3	431.50	23	532	512	91	79	386	94	93	—
—	18'9.4"	"	—	—	432.347	23	—	—	—	—	—	-	-	—
		Condensate reservoir drained at 10 min. elapsed time												
		Filter plugged at 18 min 9.4 sec elapsed time. Filter replaced												
		Probe rotated ~10° to align with flow.												
1428	0	1½ ft ℄	0.05	1.3	432.347	4.2	—	400	77	80	353	98	96	
1438	10	"	0.05	1.3	447.200	13.0	538	402	95	67	392	98	96	
—	18	"	0.05	1.3	—	21.0	542	407	95	74	402	100	96	
—	20'25.5"	"	0.05	1.3	462.670	22.5	—	—	—	—	—	—	—	
		Filter plugged at 20 min 25.5 sec elapsed time.												
	Leak rate ≈ 0.05 cfm													

KVB 6002-12

KVB, Inc. Trace Species and Organics Sampling Data

Project: _____ Personnel: McElroy, Thompson, Wood, Pienossa, Welse, Fields, Cherry Barometric Press: —

Date: 9-16-76

Location: 10

Unit: BIK. Liq. Recovery Boiler

Test: 10/2-12

Fuel: _____

Probe Nozzle Diameter (inches): — (Dn)

Absolute Static Press. in Stack (in. Hg): — (Ps)

Pitot Tube Coefficient: — (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In	Meter Out	
1359	0	1½ ft. E	0.09	2.4	469.541	6.1	533	400	86	81	352	99	99	—
1406	7	"	0.09	1.8	483.83	12.0	534	411	100	86	374	103	100	—
1413	14	"	0.09	1.8	496.20	20.0	517	401	94	86	383	108	100	—
1416	16.5	"	—	—	500.521	23.0	—	—	—	—	—	—	—	—
		Replace filter, change drierite												
1507	0	1½ ft E	0.09	1.8	500.521	5.0	—	395	87	85	365	107	106	—
1510	—	"	0.11	2.2	—	—	—	—	—	—	—	—	—	—
1512	5	"	0.11	2.2	511.300	10.0	508	396	97	67	382	113	107	
1514	—	"	0.11	3.0	—	—	—	—	—	—	—	—	—	—
1516	9.3	"	0.11	4.0	519.127	23.0	—	—	—	—	—	—	—	—

KVB 6002-12

KVB, Inc. Trace Species and Organics Sampling Data

Project: _____ Personnel: Wood, Fields, Barometric Press: 29.80

Date: 9-22-76 Pionessa, Cherry

Location: 10 _____

Unit: Black Liq. Recovery Boiler Probe Nozzle Diameter (inches): — (Dn)

Test: 10/2 -14 Absolute Static Press. in Stack (in. Hg): — (Ps)

Fuel: Black Liquor Pitot Tube Coefficient: — (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In	Meter Out	
1646	0		1.3	1.75	522.1002	5.0	281	393	106	78	386	90	88	—
1701	15	duct	1.3	1.80	548.5000	5.5	282	399	116	96	391	92	90	—
1716	30	=	1.3	1.80	574.4000	5.5	280	400	109	92	394	94	91	—
1731	45	3" from wall	1.3	1.80	600.7000	5.5	275	399	107	84	402	97	92	—
1746	60	inside	1.3	1.80	627.2000	5.5	272	399	108	83	400	100	96	—
1801	75		1.3	1.80	652.0	5.5	276	400	113	89	398	102	100	—
1816	90		1.3	1.80	677.9	6.0	284	404	120	87	400	103	101	—
1831	105		1.3	1.80	705.2	6.2	288	400	123	86	401	102	101	—
			CHANGE		DESSICANT									
1835	105	4	1.3	1.8	705.2	6.2	284	403	114	86	400	102	101	—
1850	120	"	1.3	1.8	731.1	6.5	282	399	124	78	399	100	100	—
1905	135	"	1.3	1.8	758.5	6.8	282	394	128	81	397	96	99	—
1920	150	"	1.3	1.8	784.4	6.9	282	393	128	82	396	93	96	—
1935	165	"	1.3	1.8	810.0	7.0	281	392	127	79	393	90	94	—
1950	180	"	1.3	1.8	837.1	7.0	279	403	127	77	398	89	91	—
2005	195	"	1.3	1.8	863.7	7.2	280	400	128	80	400	88	90	—

KVB 6002-12

595

KVB, Inc. Trace Species and Organics Sampling Data

Project: _____ Personnel: Pioneessa, Cherry, Barometric Press: —

Date: 9-22-76/9-23-76 Wood, Fields

Location: 10

Unit: Black Liq. Recovery Boiler Probe Nozzle Diameter (inches): — (Dn)

Test: 10/2-14 Continued Absolute Static Press. in Stack (in. Hg): — (Ps)

Fuel: Black Liquor Pitot Tube Coefficient: — (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In	Meter Out	
2020	210	"	1.3	1.8	891.0	7.2	281	402	127	79	400	88	90	—
			CHANGE DESSICANT											
2024	210	"	1.3	1.8	891.0	7.2	281	402	127	79	400	88	90	—
2034	220	"	1.3	1.8	909.8	OVEN FAN SHORT CIRCUIT - TEST STOPPED								
			RE-STARTED TEST ON 9-23-76											
1243	0	"	1.3	1.8	909.8053	6.8	276	393	108	73	391	85	85	—
1258	15	"	1.3	1.8	936.5	7.0	275	394	116	77	389	86	85	—
1301	18	"	1.2	1.65	942.9	6.6	276	399	117	79	395	86	85	—
1313	30	"	1.2	1.65	962.7	6.7	275	404	120	77	398	86	86	—
1328	45	"	1.2	1.65	988.2	6.7	275	401	118	78	398	86	86	—
1343	60	"	1.2	1.65	013.7	6.8	275	399	116	80	397	86	85	—
1403	80	"	1.2	1.65	047.1000	7.0	273	399	119	79	397	88	86	—

KVB 6002-12

KVB, Inc. Trace Species and Organics Sampling Data

Project: _____ Personnel: Pionessa, Cherry, Fields, Wood Barometric Press: 29.80

Date: 9-27-76

Location: 10

Unit: BK. Lig. Recovery Boiler

Test: 10/2-16

Fuel: Black Liquor

Note: Iced down XAD-2 Module Inlet

Probe Nozzle Diameter (inches): — (Dn)

Abeolute Static Press. in Stack (in. Hg): — (Ps)

Pitot Tube Coefficient: — (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In/Out		
1127	0		1.15	1.65	065.9100	.5	270	401	87	83	396	86	85	—
1142	15	1 ft	1.20	1.65	091.300	5.5	270	399	77	90	396	86	85	—
1157	30	from wall	1.2	1.65	117.400	6.0	273	402	74	77	401	85	85	—
1212	45	1 ft	1.2	1.65	143.300	6.1	273	401	72	69	398	86	85	—
1227	60	3 ft	1.2	1.65	169.200	6.0	275	400	75	67	400	86	86	—
			CHANGED DESSICANT											
1230	60	"	—	—	169.200	—	—	—	—	—	—	—	—	—
1245	75	"	1.15	1.65	193.9	5.5	275	400	71	69	399	87	86	—
1300	90	"	1.15	1.65	221.0	5.5	275	402	74	73	400	87	86	—
1315	105	"	1.1	1.65	245.7	5.75	276	402	71	76	400	87	87	—
1330	120	"	1.2	1.65	270.8	5.75	274	398	70	73	398	88	88	—
1345	135	"	1.3	1.65	297.4	6.0	273	402	72	71	399	89	88	—
1400	150	"	1.2	1.65	322.6	6.0	272	400	70	69	400	90	89	—
1415	165	"	1.15	1.65	348.2	6.0	273	402	71	70	401	90	89	—
1426	176	"	—	—	370.00	—	—	—	—	—	—	—	—	—
			CHANGED		DESSICANT									

KVB 6002-12

KVB, Inc. Trace Species and Organics Sampling Data

Project: _____ Personnel: Pionessa, Cherry, Fields, Wood Barometric Press: —

Date: 9-27-76

Location: 10

Unit: BIK. Liq. Recovery Boiler Probe Nozzle Diameter (inches): — (Dn)

Test: 10/2-16 continued Absolute Static Press. in Stack (in. Hg): — (Ps)

Fuel: Black Liquor Pitot Tube Coefficient: — (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In	Meter Out	
1430	176	"	1.15	1.65	370.00	7.6	273	402	72	75	400	90	90	—
1434	180	"	1.15	"	375.2	7.6	273	403	70	75	400	90	90	—
1449	195	"	1.15	"	401.1	7.9	272	402	74	76	398	91	90	—
1504	210	"	1.20	"	426.6	8.0	272	403	75	75	400	91	91	—
1520	226	"	1.20	"	454.7	8.0	275	402	71	77	400	90	91	—
1535	241	"	1.15	"	480.5	8.1	273	402	70	76	399	91	91	—
1550	256	"	1.15	"	506.9	8.2	272	399	72	76	401	92	92	—
1605	271	"	1.20	"	532.6	8.2	273	403	72	77	401	93	93	—
1620	286	"	1.20	"	559.1	8.2	272	403	72	78	399	92	92	—
1635	301	"	1.20	"	585.6034	8.2	273	403	71	78	400	91	92	—

EPA 6002-12

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 10/2-10 Date 9-15-76 Location 10 BLACK LIQUOR BOILER

Sample Port Position INLET TO PRECIPITATOR

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment
	389	S P+N+10μ SOLIDS	4oz NAL	3.6276g	
	390	S 3μ SOLIDS	"	0.8531g	
	391	S 1μ SOLIDS	"	3.9293g	17.7446g TOTAL
*	287	S #1 FILTER	PETRI	4.6578g	145.3209g TOT
	288	S #2 FILTER	PETRI	4.7874g	WT. 186.9g TOT
F *	249	L P+N+10μ WASH (1)	8 oz AMB	200ml	
	250	L " (2)	"	60ml	
	251	L 3μ WASH	"	190ml	643ml
	246	L 1μ WASH	"	108ml	
	240	L FILT. HOUS WASH	"	85ml	
	243	L XAD-2 MOD. RINSE	"	92ml	
	292	S XAD-2 RESIN	16 oz AWM	164g	443-279 TARE
	205	L XAD-2 CONDENSATE	16 oz A	353ml	
G *	818	L IMPINGER #1 (1)	16 oz AWM	293ml	100.8 AFTER TEST BOTTLE 301
	819	L " (2)	"	217ml	SPILT - PART LOST
H *	302	L IMPINGER #2 (1)	1l NAL	975ml	849 before Rinse
	303	L " (2)	"	326ml	BC1 - 849 - 452ml
	304	L IMPINGER #3 "	"	983ml	666ml (before Rinse) (17)
	201	LP HEAVY BLK LIQUOR	16 oz A	333g	612-279g T. DUP.
	297	LF LIQ. TO BURNERS (FUEL)	16 oz AWM	581g	860-279g T. DUP
	227	SP SALT CAKE	8oz A	213g	391-178g T.
	1000	SP SMELT BOTTOM ASH	32 oz GLASS	188g	638-450g T.
	COUNT	S - 5 TRAIN SOLIDS			
		L - 6 TRAIN LIQUIDS			
		LF - 1 FUEL SAMPLE			
		SP - 3 PROCESS SAMPLES			
		15 ANAL + 2 DUPLICATES			
		22 BOTTLES			

* COMBINE SAMPLES

Data Sheet KVB 6002-15

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 10/2-10 Date 9-15-76 Location 10 Black Liq. Boiler

Sample Port Position _____

SSMS Sample Combination.

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment
					Sample Fractions
A*	389	S P+N+ 10μ Solids		3.5576g	19.9
	390	3 μ Solids		0.8531g	4.8
	391	1 μ Solids		3.9293g	22.1
	287	#1 Filter		4.6572g	26.2
	288	#2 Filter		4.7874g	27.0
				17.7646	100. %
B	292	S XAD-2 Resin		164g	100. %
C*	293	L XAD-2 Mod. Rinse		92ml	2.8
	295	XAD-2 Condensate		353ml	10.7
	818 G	Imp #1 (1)		293ml	8.9
	819	" (2)		277ml	8.4
	302 H	Imp #2 (1)		975ml	29.6
	303	" (2)		326ml	9.9
	304	Imp #3		983ml	29.7
				3299	100%
D	297	F Liq. To Burners		581g	100.%
E	1000	P Smelt		188g	100 %
	Count	S - 2 Train Solids	4 Solids		
		L - 1 Train Liq.	1 Liquid		
		F (S) - 1 Fuel			
		P (S) 1 Process Sample			
		5 anal.			

Data Sheet KVB 6002-15

TEST 10/2-10 KVB ANALYSIS DATA

Sample No.	PCM's	PCB's	Remarks
389	<500 ug/g	<1000 ug/g	
380	-	-	NES
391	<200 ug/g	<500 ug/g	
287 & 288	211 ug/g	<200 ug/g	Possibility of 20 ug/g B(a)
F	<0.3 ug/l	<1 ug/l	
243	380 ug/l	<50 ug/l*	
292	784 ug/g	<25 ug/g*	
205	<1 ug/l	<5 ug/l*	
G	<0.4 ug/l	<2 ug/l	
H	<0.2 ug/l	<0.5 ug/l	
304	<0.2 ug/l	<0.5 ug/l	
201	295 ug/g	<50 ug/g	
297	209 ug/g	<100 ug/g	
227	<10 ug/g ✓	<50 ug/g	
1000	<5 ug/g ✓	<10 ug/g	

Lie in AR

*GC peaks observed but cannot be related to PCB's

NES - Not enough sample

F - 249, 250, 251, 246, 240

G - 818, 819

H - 302, 303

INLET OF PRECIPITATOR	TABLE						Test #10/2-10	
POLLUTANT	SAMPLE NUMBER							
	389+	380+	391+	287 & 288+	F*	243*	292+	205*
Antimony	<20	<40	<20	<20	<0.5	<0.5	37	<0.5
Arsenic	<1	2	5	5	<0.020	<0.020	<1	<0.020
Barium	70	80	40	20	<0.1	—	140	<0.1
Beryllium	0.2	<0.2	<0.1	<0.1	<0.003	<0.003	<0.1	<0.003
Cadmium	14	18	10	7	0.01	—	<1	<0.01
Calcium	200	110	29	28	1.3	—	440	1.3
Chromium	27	36	8	3.4	0.14	—	1.7	0.08
Cobalt	8	6	8	10	<0.02	—	<1	<0.02
Copper	3.6	3.6	2.0	2.1	0.03	—	<0.2	<0.01
Iron	210	240	110	41	1.3	—	23	4.3
Lead	16	20	18	16	<0.1	<0.1	3	<0.1
Manganese	75	54	31	28	0.11	—	0.5	1.2
Mercury	<0.5	<1.0	<0.5	<0.5	<0.005	<0.005	<0.5	<0.005
Nickel	19	20	17	8	0.12	—	<1	0.32
Selenium	<1	<2	<1	<1	<0.2	<0.1	<1	<0.03
Tellurium	<100	<200	<100	<100	<2	—	<100	<2
Tin	<50	<100	<50	<50	<3	—	<50	<3
Titanium	15	56	<15	<15	<1	—	<15	<1
Vanadium	3	<6	<3	<3	<0.1	—	<3	<0.1
Zinc	41	58	56	52	0.13	—	2.6	0.05
Chloride	47700	49400	47400	52300	105	<2	<20	49.6
Fluoride	74.7	(4600)	109	125	<0.2	<2	119	<0.2
Nitrates	<3.5	<3.5	<2.5	<2.5	<0.10	1.72	<1	<0.10
Sulfates	711000	626000	650000	750000	820	132	57.2	680

+ ug/g
* mg/l

249,250
251,246,
240

INLET OF PRECIPITATOR	TABLE						Test #10/2-10	
POLLUTANT	SAMPLE NUMBER							
	G*	E*	304*	201*	297*	227+	1000+	
Antimony	<0.5	<0.5	<0.5	<20,<20	<10,<20	<20	<20	
Arsenic	<0.020	<0.020	<0.020	<1,<1	<0.5,<1	2	<1	
Barium	<0.1	<0.1	<0.1	14,19	26,24	40	30	
Beryllium	<0.003	<0.003	<0.003	<0.1,<0.1	<0.1,<0.1	0.1	0.2	
Cadmium	<0.01	0.02	0.04	0.5,0.5	1.1,1.8	2	3	
Calcium	0.9	1.3	9.4	36,27	27,28	370	600	
Chromium	0.14	0.21	0.31	<0.4,<0.5	<0.2,<0.3	17	18	
Cobalt	0.03	0.11	0.38	2.4,2.2	3.2,3.1	12	11	
Copper	0.03	0.06	0.06	0.6,0.9	1.0,1.1	4.7	4.3	
Iron	0.63	1.3	2.2	14,17	22,44	40	110	
Lead	<0.1	<0.1	<0.1	3,2	5,8	15	3	
Manganese	0.38	0.12	0.078	25,24	27,29	2.0	96	
Mercury	<0.005	<0.005	<0.005	<0.5,<0.5	<0.2,<0.5	<0.5	<0.5	
Nickel	0.12	0.19	0.38	1.4, 1.0	4.0,3.7	10	10	
Selenium	<0.2	<0.2	<0.2	<1,<1	<0.5,<1	<1	<1	
Tellurium	<2	<2	<2	<100,<100	<50,<75	<100	<100	
Tin	<3	<3	<3	<50,<50	<25,<50	<50	<50	
Titanium	<1	<1	<1	<8,<9	<8,<9	<15	25	
Vanadium	<0.1	<0.1	<0.1	<2,<2	<1,<1	<3	4	
Zinc	0.12	0.07	1.14	2.4,2.0	3.4,4.0	5.0	7.3	
Chloride	13.9	214	103	4590	7330	7120	—	
Fluoride	<0.4	<0.1	<0.2	65.9	45.7	113	107	
Nitrates	<0.10	164	13.6	—	—	<0.50	<0.50	
Sulfates	84.0	30800	22800	—	—	651000	601000	
	818, 819	302, 303						

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

Reply to

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: February 8, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: Sample A (1-6-77) 389, 380, 391, 287, 288

IAD No.: 97-A48-134-05

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.7
Thorium		Gadolinium		Molybdenum		Titanium	≤24
Bismuth		Europium		Niobium		Scandium	≤1
Lead		Samarium		Zirconium	1	Calcium	510
Thallium		Neodymium		Yttrium		Potassium	MC
Mercury	NR	Praseodymium		Strontium	*4	Chlorine	MC
Gold		Cerium		Rubidium	63	Sulfur	MC
Platinum		Lanthanum		Bromine	31	Phosphorus	120
Iridium		Barium	8	Selenium	≤1	Silicon	210
Osmium		Cesium		Arsenic	2	Aluminum	10
Rhenium		Iodine	9	Germanium		Magnesium	330
Tungsten		Tellurium		Gallium	≤0.7	Sodium	MC
Tantalum		Antimony		Zinc	6	Fluorine	≈130
Hafnium		Tin		Copper	5	Oxygen	NR
Lutetium		Indium	STD	Nickel	36	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.6	Carbon	NR
Thulium		Silver		Iron	49	Boron	9
Erbium		Palladium		Manganese	20	Beryllium	
Holmium		Rhodium		Chromium	7	Lithium	85
Dysprosium						Hydrogen	NR

NR — Not Reported
All elements not reported <0.8 ppm weight
*Heterogeneous

Approved: M G Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 789-0454
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14233 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9851

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: February 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: Sample B (1-6-77) 292

IAD No.: 97-A48-134-05

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	1
Thorium		Gadolinium		Molybdenum		Titanium	25
Bismuth		Europium		Niobium		Scandium	≤0.3
Lead	≤9	Samarium		Zirconium		Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	37
Mercury	NR	Praseodymium		Strontium	3	Chlorine	4
Gold		Cerium		Rubidium	0.8	Sulfur	26
Platinum		Lanthanum		Bromine		Phosphorus	37
Iridium		Barium	9	Selenium		Silicon	160
Osmium		Cesium	≤1	Arsenic		Aluminum	11
Rhenium		Iodine		Germanium		Magnesium	190
Tungsten		Tellurium		Gallium	≤2	Sodium	270
Tantalum		Antimony		Zinc	9	Fluorine	≈17
Hafnium		Tin		Copper	6	Oxygen	NR
Lutetium		Indium	STD	Nickel	8	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤2	Carbon	NR
Thulium		Silver		Iron	40	Boron	≤0.1
Erbium		Palladium		Manganese	0.7	Beryllium	
Holmium		Rhodium		Chromium	5	Lithium	0.7
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported < 2 ppm weight

Approved: M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

Reply to GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 780-3454
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 46TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: February 8, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: Sample C (1-6-77) 243, 205, 818, 819, 302, 303, 304

IAD No.: 97-A48-134-05

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.005
Thorium		Gadolinium		Molybdenum		Titanium	0.8
Bismuth		Europium		Niobium		Scandium	≤0.002
Lead	0.07	Samarium		Zirconium		Calcium	7
Thallium		Neodymium		Yttrium		Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.02	Chlorine	0.09
Gold		Cerium		Rubidium	0.006	Sulfur	MC
Platinum		Lanthanum		Bromine	≤0.03	Phosphorus	0.06
Iridium		Barium	0.2	Selenium	≤0.04	Silicon	MC
Osmium		Cesium		Arsenic	0.02	Aluminum	0.4
Rhenium		Iodine		Germanium		Magnesium	2
Tungsten		Tellurium		Gallium	0.03	Sodium	>9
Tantalum		Antimony	0.1	Zinc	MC	Fluorine	≤3
Hafnium		Tin	0.03	Copper	0.02	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.2	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.1	Carbon	NR
Thulium		Silver	MC	Iron	MC	Boron	0.07
Erbium		Palladium		Manganese	0.4	Beryllium	
Holmium		Rhodium		Chromium	0.1	Lithium	0.01
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.003 µg/ml

Approved: M Jacobs

Sample was thermally ashed @350° C for one half hour in a laboratory furnace in a quartz crucible prior to analysis.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 330 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14235 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-6521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: February 8, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: Sample D (1-6-77) 297

IAD No.: 97-A48-134-05

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	Q.5
Thorium		Gadolinium		Molybdenum		Titanium	≤62
Bismuth		Europium		Niobium		Scandium	≤2
Lead	≤9	Samarium		Zirconium		Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	MC
Mercury	NR	Praseodymium		Strontium	4	Chlorine	MC
Gold		Cerium		Rubidium	≤46	Sulfur	MC
Platinum		Lanthanum		Bromine	74	Phosphorus	MC
Iridium		Barium	57	Selenium	≤5	Silicon	730
Osmium		Cesium		Arsenic	4	Aluminum	71
Rhenium		Iodine		Germanium		Magnesium	MC
Tungsten		Tellurium		Gallium	3	Sodium	MC
Tantalum		Antimony		Zinc	3	Fluorine	≈600
Hafnium		Tin	5	Copper	72	Oxygen	NR
Lutetium		Indium	STD	Nickel	15	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	2	Carbon	NR
Thulium		Silver		Iron	210	Boron	160
Erbium		Palladium		Manganese	86	Beryllium	
Holmium		Rhodium		Chromium	24	Lithium	200
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported < 2 ppm weight

Approved: M. Jacobs

Sample was thermally ashed @350° C for one half hour in a laboratory furnace in a quartz crucible prior to analysis.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 230 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-6464
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9821

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: February 8, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: Sample E (1-6-77) 1000

IAD No.: 97-A48-134-05

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.7
Thorium		Gadolinium		Molybdenum		Titanium	≤24
Bismuth		Europium		Niobium		Scandium	≤1
Lead		Samarium		Zirconium		Calcium	690
Thallium		Neodymium		Yttrium		Potassium	MC
Mercury	NR	Praseodymium		Strontium	2	Chlorine	MC
Gold		Cerium		Rubidium		Sulfur	MC
Platinum		Lanthanum		Bromine	6	Phosphorus	160
Iridium		Barium	22	Selenium	≤13	Silicon	250
Osmium		Cesium		Arsenic	2	Aluminum	18
Rhenium		Iodine		Germanium		Magnesium	330
Tungsten		Tellurium		Gallium	≤0.7	Sodium	MC
Tantalum	**19	Antimony		Zinc	24	Fluorine	MC
Hafnium		Tin		Copper	*54	Oxygen	NR
Lutetium		Indium	STD	Nickel	6	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.7	Carbon	NR
Thulium		Silver		Iron	36	Boron	34
Erbium		Palladium		Manganese	37	Beryllium	
Holmium		Rhodium		Chromium	*10	Lithium	250
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.8ppm weight
*Heterogeneous **Probable Contamination

Approved: M Y Jacobs

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 10/2-12 Date 9/16/76 Location 10 - BLACK LIQ. BOILER

Sample Port Position INLET OF PRECIPITATOR

NO SSMS ON ANY OF THESE SAMPLES

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment
	383	S P+N+10μ SOLIDS	4 oz NAL	0.6481 g	
	388	S 3μ SOLIDS	"	0.1911 g	8.4250 g TOTAL
	397	S 1μ SOLIDS	"	1.4589 g	
*	285	S #1 FILTER	PETRI	4.0787 g	149.1270 g TOT
	286	S #2 FILTER	PETRI	2.0482 g	146.6229 g TOT.
	241	L P+N+10μ WASH	8 oz AMB	211 ml	
	242	L "	"	156 ml	
I	244	L 3μ WASH	"	216 ml	
*	245	L 1μ WASH	"	188 ml	955 ml.
	247	L FILT. HOLD WASH	"	165 ml	
	248	L "	"	79 ml	
*	235	L XAD-2 MOD RINSE	8 oz AMB.	168 ml	224 ml
	233	L "		56 ml	
	291	S XAD-2 RESIN	16 oz AWM	153 g	457 g - 279 g TUBE
	314	L IMPINGER #1	1 l NAL	985 ml	793 ml BEF. RINSE
	315	L IMPINGER #2	"	948 ml	741 ml BEF. RINSE
	316	L IMPINGER #3	"	924 ml	734 ml BEF. RINSE
	206	L XAD-2 CONDENSATE	16 oz A	246 ml	
	228	LB DIST. H_2O BLANK	8 oz A	148 ml	
	229	LB 50/50 CH_3OH H_2O BLANK	"	78 ml	
	230	LB IPA BLANK	"	122 ml	
	231	LB H_2O_2 IMPINGER #1 BLANK	"	122 ml	
(X)	1001	P SALT CAKE SAMPLE	GLASS	455.3 g	905.3-450
	1002	P(S) SMELT BOTTOM ASH	"	146.5 g	596.5-450
	1003	F(S) LIQ. TO BURNERS (FUEL)	"	454.4 g	904.4-450
(X)	1004	P HEAVY LIQ.	"	390.5 g	840.5-450
	COUNT	S - 5 TRAIN SOLIDS	(X) DO NOT ANALYZE		
		L - 6 TRAIN LIQUIDS	* COMBINE		

F - 1 FUEL
LB - 4 LIQ. BLANKS
P - 1 PROCESS MTLS
17 ANALYSES

25 BOTTLES

Data Sheet KVB 6002-15

TEST 10/2-12 KVB ANALYSIS DATA

Sample No.	POM's	PCB's	Remarks
383	-	-	NES
328	-	-	NES
397	-	-	NES
285-286	0.29 ug/g 1.74	<100 ug/g	
I	<0.2 ug/g l	<0.5 ug/g	
235	-	-	NES
291	50 ug/g 7650	<25 ug/g	
206	<1 ug/g l	<5 ug/g	
314	<0.2 ug/g l	<0.5 ug/g	
315	1.26 ug/l 1194 ug	<1 ug/l	
316	<0.4 ug/l	<1 ug/l	
228	-	-	NES
229	-	-	NES
230	-	-	NES
231	-	-	NES
1002	<10 ug/g	<50 ug/g	
1003	117 ug/g	<50 ug/g	

NES - Not enough sample

I - 241, 242, 244, 245, 247, 248

INLET OF PRECIPITATOR — TABLE — Test #10/2-12

POLLUTANT	SAMPLE NUMBER							
	383+	388+ (328+)	397+	285 & 286+	I*	235*	291+	206*
Antimony	<20	<100	<20	<20	<0.5	<1	<20	<0.5
Arsenic	<2	<50	<1	<1	<0.020	<0.02	<1	<0.020
Barium	30	20	20	32	<0.1	<0.05	10	<0.1
Beryllium	<0.2	<1	<0.1	<0.1	<0.003	<0.005	<0.1	<0.003
Cadmium	15	31	10	10	0.02	<0.01	<1	0.04
Calcium	200	300	36	23	1.5	0.66	15	1.6
Chromium	58	41	18	6.2	0.27	0.36	7.2	0.31
Cobalt	12	<10	6	7	0.07	<0.02	<1	0.04
Copper	4.0	<2	2.5	2.2	0.04	<0.01	0.7	<0.01
Iron	370	250	130	41	1.1	4.2	35	4.4
Lead	25	<20	20	28	<0.1	<0.02	2	<0.1
Manganese	74	44	28	20	0.066	0.40	0.9	0.38
Mercury	<1	<10	<1	<0.5	<0.005	<0.005	<0.5	<0.005
Nickel	38	<10	20	6	0.10	0.40	<1	0.49
Selenium	<2	50	<1	<1	<0.2	<0.02	10	<0.05
Tellurium	<200	<1000	<100	<100	<2	<3	<100	<2
Tin	<100	<500	<50	<50	<3	<1	<50	<3
Titanium	30	<150	<15	<15	<1	<0.5	<15	<1
Vanadium	<6	<30	<3	<3	<0.1	<0.1	<3	<0.1
Zinc	52	73	39	33	0.09	0.11	2.3	0.15
Chloride	31100	50300	30400	34900	53.6	9.92	96.6	11.9
Fluoride	(4200)	775	<1000	40.0	0.36	1.1	55.0	0.54
Nitrates	<8	<60	18.5	27.8	<0.10	0.40	<1	0.58
Sulfates	44200	693000	593000	670000	430	58.0	97.4	340

241,242
244,245
247,248

INLET OF PRECIPITATOR	TABLE						Test #10/2-12	
POLLUTANT	SAMPLE NUMBER							
	314*	315*	316*	228*	229*	230*	231*	1002+
Antimony	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<20
Arsenic	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<1
Barium	<0.1	<0.1	<0.1	<0.1	—	<0.1	<0.1	40
Beryllium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.1
Cadmium	<0.01	0.05	0.04	<0.01	—	<0.01	<0.01	2
Calcium	0.2	0.4	0.7	1.2	—	0.4	0.7	950
Chromium	0.16	0.25	0.29	<0.02	—	0.05	0.09	17
Cobalt	<0.02	0.08	0.08	<0.02	—	0.03	<0.02	12
Copper	<0.01	0.03	0.05	0.03	—	<0.01	0.02	8.3
Iron	0.71	1.4	2.2	0.03	—	<0.02	0.04	150
Lead	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	8
Manganese	0.035	0.076	0.068	<0.005	—	<0.005	<0.005	110
Mercury	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5
Nickel	<0.05	0.17	0.26	0.14	—	<0.05	<0.05	10
Selenium	<0.05	<0.2	<0.2	<0.02	<0.02	<0.05	<0.01	<1
Tellurium	<2	<2	<2	<2	—	<2	<2	<100
Tin	<3	<3	<3	<3	—	<3	<3	<50
Titanium	<1	<1	<1	<1	—	<1	<1	20
Vanadium	<0.1	<0.1	<0.1	<0.1	—	<0.1	<0.1	<3
Zinc	0.07	0.17	0.46	1.14	—	0.04	0.03	10
Chloride	<2	4930	420	1.06	<2	1.98	59.6	37800
Fluoride	<0.4	<0.2	<0.2	<0.1	<1	<0.1	<0.4	95.0
Nitrates	20.4	1.80	14.2	<0.10	<0.10	<0.10	14.2	<0.50
Sulfates	268	32000	32000	<3	10.0	10.0	10.0	641000

INLET OF PRECIPITATOR	TABLE							Test #10/2-12
POLLUTANT	SAMPLE NUMBER							
	1003+							
Antimony	<20, 15							
Arsenic	<1, <1							
Barium	42, 40							
Beryllium	<0.1, <0.1							
Cadmium	1.7, 1.0							
Calcium	47, 42							
Chromium	<0.6, <0.4							
Cobalt	2.4, 2.2							
Copper	1.0, 1.0							
Iron	39, 30							
Lead	8, 6							
Manganese	32, 32							
Mercury	<0.5, <0.2							
Nickel	3.4, 3.4							
Selenium	<1, <0.5							
Tellurium	<100, <50							
Tin	<50, <25							
Titanium	<11, <5							
Vanadium	<2, <1							
Zinc	6.9, 5.7							
Chloride	7280							
Fluoride	74.0							
Nitrates	—							
Sulfates	—							

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 10/2-14 Date 9/22-23/76 Location 10 - BLACK LIQUOR BOILER

Sample Port Position OUTLET OF PRECIPITATOR

NO SSMS ON THESE SAMPLES

	Container Number		Sample Description	Container Type	Net wt/vol.	Comment
	398	S	P+N+10μ SOLIDS	4 oz NAL	0.0669g	
	NONE	S	3μ SOLIDS	—	—	
	396	S	1μ SOLIDS	4 oz NAL	0.1125g	0.482g TOT.
	279	S	#1 FILTER	PETRI	0.3134g	149.6160 TOT.
J *	232	L	P+N+10μ WASH (1)	8 oz A	225ml	
	234	L	" (2)	"	194ml	
	236	L	3μ WASH	"	158ml	914ml
	238	L	1μ WASH	"	164ml	
	239	L	FILT. HOUS WASH	"	173ml	
	225	L	XAD-2 MODULE RINSE	"	215ml	
	293	S	XAD-2 RESIN	16 oz AWM	1586g	487.0-279
X	203	L	XAD-2 CONDENSATE (1)	16 oz A	405ml	SAMPLE LOST CAP OFF
K *	202	L	" (2)	"	403ml	
	210	L	" (3)	"	415ml	
	211	L	" (4)	"	287ml	388ml
	313	L	" (5)	1l NAL	857ml	
	317	L	" (6)	"	981ml	
L *	318	L	IMPINGER #1 (1)	"	1005ml	2373ml after rinse 2003ml before rinse
	319	L	" (2)	"	1010ml	370ml IPA wipe added.
	322	L	" (3)	"	358ml	
N *	320	L	IMPINGER #2 (1)	"	945ml	1861 after 851 before
	323	L	" (2)	"	946ml	1040 Rinse
N *	321	L	IMPINGER #3 (1)	"	998ml	827 after 804 before
	324	L	" (2)	"	829ml	1023 Rinse
X	1005		SALT CAKE 9/22	GLASS	338g	
X	1006		SALT CAKE 9/23	"	318g	
	1007	P	SMELT (ASH) 9/22	"	272g	
	1008	P	SMELT (ASH) 9/23	"	194g	

Data Sheet KVB 6002-15

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 10/2-14 Date 8/22-23/76 Location 10 - Black Liq. Boiler

Sample Port Position Outlet Of Precipitator.

Container Number	Sample Description	Container Type	Net wt/vol.	Comment
1009	F Liquor To Burners (8/22)	Glass	428 g	
1010	F Liquor To Burners (8/23)	"	399 g	
(X) 1011	Heavy Liquor (8/22)	"	484 g	
(X) 1012	Heavy Liquor (8/23)	"	414 g	
Count	S - 4 Solids	14 Analyses		
	L - 6 Liquids	30 Bottles		
	F - 2 Fuels			
	P - 2 Process Htls			
*	Combine Samples For Analyses			
(X)	Do Not Analyze			

Data Sheet KVB 6002-15

TEST 10/2-14 KVB ANALYSIS DATA

Sample No.	PCM's	PCB's	Remarks
398	-	-	NES
396	-	-	NES
279	-	-	NES
J	0.37 ug/l 358	<0.5 ug/l*	
225	613 ug/l 131795	<5 ug/l*	
293	4900 ug/g 779100	<25 ug/g*	
K	<0.2 ug/l	<0.5 ug/l*	
L	<0.2 ug/l	<0.5 ug/l	
M	11.8 ug/l 12313	<1 ug/l	Possibility of 0.33 ug/g B(a)
N	0.42 ug/l	<1 ug/l	
1007	<10 ug/g	<50 ug/g*	
1008	<10 ug/g	<50 ug/g*	
1009	68 ug/g	<50 ug/g	
1010	78 ug/g	<50 ug/g	

*GC peaks observed but can't be related to PCB's

NES - Not enough sample

J - 232, 234, 236, 238, 239
K - 202, 210, 211, 313, 317
L - 318, 319, 322
M - 320, 323
N - 321, 324

OUTLET OF PRECIPITATOR	TABLE							Test #10/2-14
POLLUTANT	SAMPLE NUMBER							
	M*	N*	1007+	1008+	1009+	1010+		
Antimony	<0.5	<0.5	<20	<20	<20, <20	<20, <20		
Arsenic	<0.020	<0.020	<1	<1	<1, <1	<1, <1		
Barium	<0.1	<0.1	30	40	24, 28	40, 25		
Beryllium	<0.003	<0.003	0.3	0.1	<0.1, <0.1	<0.1, <0.1		
Cadmium	0.01	0.04	3	2	1.7, 1.5	0.9, 0.6		
Calcium	0.5	0.4	800	800	57, 58	35, 44		
Chromium	0.26	0.85	14	20	<0.6, 1.0	<0.7, <0.5		
Cobalt	0.05	0.12	15	11	2.9, 3.6	2.2, 1.8		
Copper	0.02	0.02	3.7	4.4	1.7, 2.3	1.2, 1.0		
Iron	1.7	6.2	120	110	28, 25	20, 21		
Lead	<0.1	<0.1	7	6	6, 8	4, 4		
Manganese	0.067	0.14	96	100	32, 32	29, 28		
Mercury	<0.005	<0.005	<0.5	<0.5	<0.5, <0.5	<1, <0.5		
Nickel	0.15	0.65	10	10	3.4, 2.2	<1.3, 1		
Selenium	<0.2	<0.2	<1	<1	<2, <1	<2, <1		
Tellurium	<2	<2	<100	<100	<150, <100	<150, <100		
Tin	<3	<3	<50	<50	<50, <50	<50, <50		
Titanium	<1	<1	<15	<15	<12, <10	<12, <10		
Vanadium	<0.1	<0.1	3	<3	<2, <2	<3, <2		
Zinc	0.08	0.05	12	10	9.0, 11	6.9, 6.2		
Chloride	1050	671	26800	32000	6780	6710		
Fluoride	0.26	0.42	156	148	106	99		
Nitrates	1.56	2.16	<0.50	<0.50	—	—		
Sulfates	17000	16000	474000	487000	—	—		

320, 323 321, 324

OUTLET OF PRECIPITATOR			TABLE				Test #10/2-14	
POLLUTANT	SAMPLE NUMBER							
	398+	396+	279+	J*	225*	293#	K*	L*
Antimony	<200	<200	<20	<0.5	<0.5	<20	<0.5	<0.5
Arsenic	<10	<10	<1	<0.020	<0.020	<1	<0.020	<0.020
Barium	10	20	130	<0.1	<0.1	10	<0.1	<0.1
Beryllium	<2	<1	0.36	<0.003	<0.003	<0.1	<0.003	<0.003
Cadmium	<20	<10	5	<0.01	0.01	2	0.01	<0.01
Calcium	160	140	37000	1.0	1.9	41	0.8	0.9
Chromium	76	88	20	0.08	0.26	3.2	<0.02	0.16
Cobalt	<20	<11	10	0.05	<0.02	<1	<0.02	<0.02
Copper	14	6.6	9.5	0.03	0.02	0.5	<0.01	0.03
Iron	1100	660	1100	0.42	2.1	22	0.08	0.85
Lead	<80	<30	25	<0.1	<0.1	<2	<0.1	<0.1
Manganese	44	41	36	0.018	0.085	0.5	0.020	0.036
Mercury	< 10	<5	<0.5	<0.005	<0.005	<0.5	<0.005	<0.005
Nickel	<20	33	11	<0.05	0.19	<1	<0.05	<0.05
Selenium	200	10	40	<0.001	<0.1	<1	<0.02	<0.02
Tellurium	<2000	<1000	<100	<2	<2	<100	<2	<2
Tin	<1000	<500	<50	<3	<3	<50	<3	<3
Titanium	400	300	140	<1	<1	<15	<1	<1
Vanadium	<60	<33	4	<0.1	<0.1	<3	<0.1	<0.1
Zinc	120	87	37	0.05	0.48	3.0	0.02	0.14
Chloride	64500	133000	88000	29.8	13.9	<20	<2	<2
Fluoride	(28800)	(46400)	(3090)	<0.2	0.56	100	<0.2	<0.3
Nitrates	<350	<800	<90	<0.10	1.12	<1	<0.10	31.6
Sulfates	574000	723000	594000	58.0	16.0	19.1	60.0	260
				232,234 236,238 239			202,210 211,313 317	318, 319, 322

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 10/2-16 Date 9/27/76 Location 10 - Black Liq. Boiler

Sample Port Position Outlet Of Precipitator

	Container Number		Sample Description	Container Type	Net wt/vol.	Comment
	381	S	P+N + 10μ Solids	4 oz Nal	0.1076g	0.4354g Tot.
	None	S	3μ Solids	—	—	
	382	S	1μ Solids	4 oz Nal	0.0775g	
	280	S	#1 Filter	Petri	0.2503g	142.6788 Tot.
A' *	448	L	P+N+10μ Wash (1)	16 oz A	410ml	840ml.
A' *	None	L	" (2)	•		
A' *	256	L	3μ Wash	8 oz A	212ml	
A' *	257	L	1μ Wash	"	133ml	
A' *	252	L	Filt. Hous Wash	"	85ml	
	267	L	XAD-2 Module Rinse	"	198ml	
	294	S	XAD-2 Resin	16 oz AWM	180g	4594 - 279g
F' *	325	L	XAD-2 Condensate (1)	1/2 N	921ml	4607ml Tot.
F' *	326	L	" (2)	"	933ml	
F' *	327	L	" (3)	"	988ml	
F' *	328	L	" (4)	"	958ml	
F' *	329	L	" (5)	"	807ml	
G' *	305	L	Impinger #1 (1)	"	670ml	1201 after / 940 before / 381 final
G' *	306	L	" (2)	"	621ml	
H' *	307	L	Impinger #2 (1)	"	908ml	1849 / 1040 / 809 final
H' *	309	L	" (2)	"	941ml	
I' *	310	L	Impinger #3 (1)	"	721ml	1428 / 450 / 978 final
I' *	312	L	" (2)	"	707ml	
	1013	P	Smelt	Glass	128g	
	1014	F	Liquor To Burner	"	264g	
(X)	1015	P	Heavy Liquor	"	555g	
	Count		S - 4 Train Solids	* Combine Samples		
			L - 6 Train Liquids	(X) Do Not Analyze		
			F - 1 Fuel			

P - 2 Process Mtls
12 Analyses
23 Bottles Sent

Data Sheet KVB 6002-15

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 10/2-16 Date 9/27/76 Location 10-BLACK LIQ. BOILER

Sample Port Position _____

SSMS SAMPLES

	Container Number		Sample Description	Container Type	Net wt/vol.	Comment
			NO SSMS ON SOLIDS - INSUFFICIENT SAMPLE			
			DO WASHES INSTEAD			
A.	448	L	RINSE & WASH		410 ml	48.8
	226		3 M WASH		212 ml	25.2
	237		1 M WASH		133 ml	15.8
	252		FILT. HOUS WASH		85 ml	10.2
					840 ml	100.0%
B	294	S	XAD-2 RESIN		180 g	100.0%
C	257	L	XAD-2 HOD. RINSE		198 ml	21%
	325 F	I	XAD-2 CONDENSATE		921 ml	
	326		"		933 ml	
	327		"		988 ml	4607 ml 49.2%
	328		"		958 ml	
	329		"		807 ml	
	305 G		IMPINGER #1 (1)		670 ml	891 ml 13.8%
	306		" (2)		221 ml	
	307 H		IMPINGER #2 (1)		508 ml	1949 ml 18.7%
	308		" (2)		941 ml	
	310 I		IMPINGER #3 (1)		721 ml	1428 ml 15.2%
	312		" (2)		707 ml	
V					9313 ml	100.0%
D	1014	F	L.Q. TO BOILER (FUEL)		264 g	100.%
E	1013	P	SHELF		123 g	100%
	COUNT	S	1 TRAIN SOLIDS			
		L	2 TRAIN LIQUIDS			
		F	1 FUEL			
		P	1 PROCESS H₂O			

5 ANALYSES

Data Sheet KVB 6002-15

TEST 10/2-16 KVB ANALYSIS DATA

Sample No.	PCM's	PCB's	Remarks
381	-	-	NES
382	-	-	NES
280	-	-	NES
A'	1.8 ug/l	<1 ug/l	
267	9,810 ug/l	<5 ug/l*	
294	382 ug/g	<10 ug/g	Possibility of 10 ug/g B(a)P
F'	0.26 ug/l	<0.5 ug/l	
G'	0.53 ug/l	<0.5 ug/l*	
H'	<0.4 ug/l	<1 ug/l	
I'	<0.4 ug/l	<1 ug/l*	
1013	<20 ug/g	<50 ug/g	
1014	<20 ug/g	<50 ug/g	

*GC peaks observed but can't be related to PCB's

NES - Not enough sample

A' - 448, 226, 237, 252
F' - 325, 326, 327, 328, 329
G' - 305, 306
H' - 307, 309
I' - 310, 312

OUTLET OF PRECIPITATOR	TABLE							Test #10/2-16
POLLUTANT	SAMPLE NUMBER							
	381+	382+	280+	A *	267*	294+	F*	G*
Antimony	<200	<200	<20	<0.5	<1	<50	<0.5	<0.5
Arsenic	<10	<10	<1	<0.020	<0.020	<0.1	<0.020	<0.020
Barium	—	—	—	—	<0.05	12	—	—
Beryllium	<2	<1	<1	<0.003	<0.005	0.4	<0.003	<0.003
Cadmium	—	—	—	<0.01	<0.01	1.0	<0.01	<0.01
Calcium	—	—	—	1.3	0.50	100	0.9	0.4
Chromium	—	—	—	0.15	0.23	1.5	0.05	0.31
Cobalt	—	—	—	<0.02	<0.02	20	<0.02	<0.02
Copper	—	—	—	<0.01	<0.01	1.5	<0.01	0.03
Iron	—	—	—	0.41	1.4	140	0.04	0.22
Lead	<100	<50	25	<0.1	<0.02	10	<0.1	<0.1
Manganese	—	—	—	0.024	0.05	3	0.035	0.021
Mercury	<10	<5	<5	<0.005	<0.005	<0.5	<0.005	<0.005
Nickel	—	—	—	<0.05	0.11	4	<0.05	<0.05
Selenium	200	5	20	<0.01	<0.02	<5	<0.01	<0.01
Tellurium	—	—	—	<2	<3	<100	<2	<2
Tin	—	—	—	<3	<1	<50	<3	<3
Titanium	—	—	—	<1	<0.5	150	<1	<1
Vanadium	—	—	—	<0.1	<0.1	<5	<0.1	<0.1
Zinc	—	—	—	0.06	0.37	6.6	0.13	0.10
Chloride	68800	68100	47600	23.4	12.8	10.6	4.26	14.9
Fluoride	(1370)	(1610)	(2440)	0.58	<0.4	34.2	<0.2	<0.3
Nitrates	<55	<90	<265	<0.20	<0.20	0.70	<0.20	0.48
Sulfates	591000	545000	50800	96	25	<38	102	58
				448,226 237,252			325,326 327,328 329	305 306

OUTLET OF PRECIPITATOR	TABLE							Test 10/2-16
POLLUTANT	SAMPLE NUMBER							
	H*	I*	1013+	1014+				
Antimony	<0.5	<0.5	<50	<20, <30				
Arsenic	<0.020	<0.020	<0.2	<1, <2				
Barium	—	—	22	37, 22				
Beryllium	<0.003	<0.003	0.5	<0.1, <0.1				
Cadmium	<0.01	0.02	0.5	1.1, 0.6				
Calcium	0.7	0.6	220	28, 31				
Chromium	0.31	0.44	1.5	<0.5, <0.8				
Cobalt	0.07	0.05	12	2.6, 2.6				
Copper	0.03	0.02	2.5	1.4, 1.4				
Iron	1.7	2.0	90	16, 11				
Lead	<0.1	<0.1	5	6, 8				
Manganese	0.077	0.073	100	32, 33				
Mercury	<0.005	<0.005	<0.5	<0.5, <1				
Nickel	0.19	0.26	3	1, <1.5				
Selenium	<0.1	<0.2	<5	<1, <2				
Tellurium	<2	<2	<100	<100, <50				
Tin	<3	<3	<50	<50, <100				
Titanium	<1	<1	100	<10, <15				
Vanadium	<0.1	<0.1	<5	<2, <3				
Zinc	0.09	0.15	11	5.6, 5.3				
Chloride	34.0	46.8	125000	6900				
Fluoride	<0.2	0.75	86	47.5				
Nitrates	4.56	2.12	<0.50	—				
Sulfates	28000	13500	600000	—				
	307, 309	310, 312						

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 787-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14338 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 8, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 10/2 - 16 A Comp. 448, 226, 237, 252

IAD No.: 97-A101-134-21

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.06	Terbium		Ruthenium		Vanadium	≤0.002
Thorium	≤0.08	Gadolinium		Molybdenum	0.07	Titanium	0.04
Bismuth	≤0.02	Europium		Niobium		Scandium	≤0.01
Lead	0.05	Samarium		Zirconium	0.03	Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.04	Chlorine	2
Gold		Cerium		Rubidium	0.02	Sulfur	MC
Platinum		Lanthanum		Bromine	0.08	Phosphorus	0.7
Iridium		Barium	0.04	Selenium	≤0.02	Silicon	2
Osmium		Cesium	0.003	Arsenic	≤0.004	Aluminum	0.1
Rhenium		Iodine	≤0.01	Germanium	≤0.005	Magnesium	3
Tungsten		Tellurium		Gallium	≤0.007	Sodium	MC
Tantalum		Antimony		Zinc	0.1	Fluorine	*1
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.04	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.007	Carbon	NR
Thulium		Silver	≤0.01	Iron	0.5	Boron	0.02
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	*0.4	Lithium	0.02
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported < 0.008 µg/ml
*Heterogeneous

Approved: M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 738-9494
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14325 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9121

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 8, 197

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 10/2 - 16 B Comp. 294 1/27/77

IAD No.: 97-A101-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.3
Thorium		Gadolinium		Molybdenum	≤2	Titanium	3
Bismuth		Europium		Niobium		Scandium	≤0.1
Lead	≤2	Samarium		Zirconium	≤0.9	Calcium	270
Thallium		Neodymium		Yttrium		Potassium	16
Mercury	NR	Praseodymium		Strontium	0.4	Chlorine	34
Gold		Cerium		Rubidium	0.2	Sulfur	18
Platinum		Lanthanum		Bromine	≤2	Phosphorus	*8
Iridium		Barium	2	Selenium		Silicon	82
Osmium		Cesium		Arsenic	≤0.3	Aluminum	66
Rhenium		Iodine		Germanium		Magnesium	57
Tungsten		Tellurium		Gallium	≤0.4	Sodium	17
Tantalum		Antimony		Zinc	2	Fluorine	*8
Hafnium		Tin	≤1	Copper	2	Oxygen	NR
Lutetium		Indium	STD	Nickel	*2	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.1	Carbon	NR
Thulium		Silver		Iron	7	Boron	1
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	2	Lithium	0.3
Dysprosium						Hydrogen	NR

*Heterogeneous
NR – Not Reported
All elements not reported <0.5 ppm weight

Approved: M. J. Jacobs

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucible prior to analysis.

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 239 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 10/2 16 C #267, 325, 326, 327, 328, 329, 305, 306, 307, 309, 310, 312

IAD No.: 97-A101-134-21

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.02
Thorium		Gadolinium		Molybdenum	0.04	Titanium	≤0.2
Bismuth		Europium		Niobium	0.03	Scandium	≤0.009
Lead	≤0.03	Samarium		Zirconium	0.01	Calcium	MC
Thallium		Neodymium		Yttrium	≤0.006	Potassium	3
Mercury	NR	Praseodymium	0.01	Strontium	0.01	Chlorine	1
Gold		Cerium	0.01	Rubidium	0.003	Sulfur	MC
Platinum		Lanthanum	0.04	Bromine	0.05	Phosphorus	3
Iridium		Barium	0.06	Selenium	0.4	Silicon	*2
Osmium		Cesium	0.004	Arsenic	≤0.004	Aluminum	0.08
Rhenium		Iodine	0.009	Germanium		Magnesium	2
Tungsten		Tellurium		Gallium	0.02	Sodium	MC
Tantalum		Antimony	0.1	Zinc	0.5	Fluorine	*4
Hafnium		Tin	0.2	Copper	0.08	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.1	Nitrogen	NR
Ytterbium		Cadmium	≤0.01	Cobalt	0.006	Carbon	NR
Thulium		Silver	MC	Iron	0.8	Boron	0.2
Erbium		Palladium		Manganese	0.08	Beryllium	
Holmium		Rhodium		Chromium	0.3	Lithium	0.04
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported < 0.007 µg/ml
*Heterogeneous

Approved: M Specola

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 8, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 10/2 - 16 D Composite #1014 1/27/77

IAD No.: 97-A101-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.3	Terbium	<0.1	Ruthenium		Vanadium	0.4
Thorium	≤0.4	Gadolinium	0.1	Molybdenum	2	Titanium	1
Bismuth	≤0.1	Europium	0.1	Niobium	≤0.1	Scandium	≤0.1
Lead	0.4	Samarium	0.3	Zirconium	0.2	Calcium	280
Thallium		Neodymium	0.1	Yttrium	<0.1	Potassium	>600
Mercury	NR	Praseodymium	0.1	Strontium	2	Chlorine	MC
Gold		Cerium	0.2	Rubidium	14	Sulfur	>300
Platinum		Lanthanum	0.5	Bromine	8	Phosphorus	560
Iridium		Barium	52	Selenium	0.3	Silicon	330
Osmium		Cesium	0.3	Arsenic	2	Aluminum	>49
Rhenium		Iodine	1	Germanium	0.3	Magnesium	450
Tungsten		Tellurium		Gallium	0.2	Sodium	>150
Tantalum		Antimony	0.2	Zinc	6	Fluorine	≈68
Hafnium		Tin	≤0.1	Copper	2	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.9	Nitrogen	NR
Ytterbium		Cadmium	≤0.1	Cobalt	0.07	Carbon	NR
Thulium		Silver		Iron	29	Boron	15
Erbium		Palladium		Manganese	50	Beryllium	<0.1
Holmium		Rhodium		Chromium	0.4	Lithium	>140
Dysprosium						Hydrogen	NR

NR — Not Reported
All elements not reported <0.1 ppm weight

Approved: M. Jacobs

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucible prior to analysis.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

Reply to

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 9, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 10/2 16 E Comp. #1013 1/27/77

IAD No.: 97-A101-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤1	Terbium		Ruthenium		Vanadium	0.3
Thorium	≤2	Gadolinium		Molybdenum	0.8	Titanium	22
Bismuth	≤0.4	Europium		Niobium		Scandium	≤2
Lead	≤0.8	Samarium		Zirconium		Calcium	430
Thallium		Neodymium		Yttrium	≤0.1	Potassium	MC
Mercury	NR	Praseodymium		Strontium	2	Chlorine	MC
Gold		Cerium	0.2	Rubidium	33	Sulfur	MC
Platinum		Lanthanum	0.5	Bromine	4	Phosphorus	650
Iridium		Barium	9	Selenium	≤0.7	Silicon	260
Osmium		Cesium	0.2	Arsenic	3	Aluminum	6
Rhenium		Iodine	2	Germanium		Magnesium	170
Tungsten		Tellurium		Gallium	0.6	Sodium	MC
Tantalum		Antimony		Zinc	10	Fluorine	≈67
Hafnium		Tin	≤0.4	Copper	2	Oxygen	NR
Lutetium		Indium	STD	Nickel	2	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.1	Carbon	NR
Thulium		Silver		Iron	37	Boron	24
Erbium		Palladium		Manganese	210	Beryllium	
Holmium		Rhodium		Chromium	0.1	Lithium	18
Dysprosium						Hydrogen	NR

NR — Not Reported
All elements not reported <0.2 ppm weight

Approved: M J Jacobs

CARBON MONOXIDE BOILER

Location No. 11 Unit No.

Unit Description CARBON MONOXIDE (CO) BOILER
CO GAS FROM FLUID CATALYTIC CRACKING UNIT (FCCU) REGENERATOR
136,000 kg/hr (300,000 lb/hr)

Installation Date

Heater Rating 135 MW (461×10^6 Btu/hr)

Burner Description 4 B&W SPUD TYPE GAS BURNERS

Test Fuel Combinations REFINERY GAS AND CO GAS
REFINERY GAS

Fuel Temp. at Burner (°F)

Primary Air Temp. (°F) 769 K (925 °F)

Comments:

MOBILE LABORATORY DATA

Test No. 11-1

Test No. 11-1 Date 9-7-76 Location 11 Engr. Wood

Unit No. 2 Fuel CO + Ref. Gas Capacity 300K lb steam/hr - full load

Unit Type CO Boiler Burner Type 4 - Spud Gas Burners

1. Test No.	11-1		11-1		11-1		11-1		11-1	
2. Date	9-7-76		9-7-76		9-7-76		9-7-76		9-7-76	
3. Time	1440		1445		1448		1451		1455	
4. Load K lb steam/hr	302		302		302		302		302	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(1)		(7)		(8)		(9)		COMPOSITE	
8. Oxygen (%)	2.0		1.9		2.3		2.0		2.0	
9. NOx (hot) read/3% O_2 (ppm)	110	104	+		+		+		+	
10. NO (hot) read/3% O_2 (ppm)	110	104	+		+		+		+	
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	+		+		+		+	
12. NO (cold) read/3% O_2 (ppm)	140	133	120	113	132	127	140	133	140	133
13. Carbon Dioxide (%)	13.6		14.0		13.6		14.0		14.0	
14. Carbon Monoxide (ppm) uncor/cor	24	23	20	19	28	27	40	38	36	34
15. Hydrocarbon (ppm) uncor/cor	10	9	+		+		+		+	
16. Sulfur Dioxide (ppm) uncor/cor	760	720	+		+		+		+	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	92		92		92		92		92	
19. Dew Point Temp. (°F/°C)	78		78		78		78		78	
20. Atmos. Pressure (in. Hg)	29.88		29.88		29.88		29.88		29.88	
21. Relative Humidity (%)	54		54		54		54		54	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 11-2

Test No. 11-2 Date 9-7-76 Location 11 Engr. Wood

Unit No. 2 Fuel CO + Ref. Gas Capacity

Unit Type CO Boiler Burner Type B&W Spud

1. Test No.	11-2		11-2								
2. Date	9-7-76		9-7-76								
3. Time	1523		1528								
4. Load K lb steam/hr	310		310								
5. Process Rate											
6. Flue Diam. or Size, ft											
7. Probe Position	(1),(8),(9)		(8)								
8. Oxygen (%)	1.7		1.8								
9. NOx (hot) read/3% O_2 (ppm)	—										
10. NO (hot) read/3% O_2 (ppm)	—										
11. NO_2 (hot) read/3% O_2 (ppm)	—										
12. NO (cold) read/3% O_2 (ppm)	130	121									
13. Carbon Dioxide (%)	14.4										
14. Carbon Monoxide (ppm) uncor/cor	140	131									
15. Hydrocarbon (ppm) uncor/cor	—										
16. Sulfur Dioxide (ppm) uncor/cor	—										
17. Smoke Spot (Bacharach)	—										
18. Atmos. Temp. (°F/°C)	93		93								
19. Dew Point Temp. (°F/°C)	81		81								
20. Atmos. Pressure (in. Hg)	29.86		29.86								
21. Relative Humidity (%)	60		60								
22.											
23.											
24.											
25.											
26.											
27.											
28.											
29.											
30.											

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 11-3

Test No. 11-3 Date 9-8-76 Location 11 Engr. Wood

Unit No. 2 Fuel CO+ Ref. Gas Capacity

Unit Type CO Boiler Burner Type B&W Spud

1. Test No.	11-3		11-3		11-3		11-3		11-3	
2. Date	9-8-76		→		→		→		→	
3. Time	1010		1015		1018		1021		1024	
4. Load K lb steam/hr.	280		→		→		→		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	①		⑦		⑧		⑨		COMP.	
8. Oxygen (%)	1.9		1.8		2.2		1.9		1.9	
9. NOx (hot) read/3% O_2 (ppm)	116	109	+		+		+		+	
10. NO (hot) read/3% O_2 (ppm)	115	108	+		+		+		+	
11. NO_2 (hot) read/3% O_2 (ppm)	1	1	+		+		+		+	
12. NO (cold) read/3% O_2 (ppm)	147	139	146	137	145	139	144	136	144	136
13. Carbon Dioxide (%)	13.2		13.6		13.6		13.9		14.4	
14. Carbon Monoxide (ppm) uncor/cor	48	45	40	37	48	46	44	41	48	45
15. Hydrocarbon (ppm) uncor/cor	10	9	+		+		+		+	
16. Sulfur Dioxide (ppm) uncor/cor	700	660	+		+		+		+	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	88		→		→		→		→	
19. Dew Point Temp. (°F/°C)	77		→		→		→		→	
20. Atmos. Pressure (in. Hg)	30.03		→		→		→		→	
21. Relative Humidity (%)	74		→		→		→		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Baseline

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 11-4

Test No. 11-4 Date 9-8-76 Location 11 Engr. Wood

Unit No. 2 Fuel 60+ Ref. Gas Capacity

Unit Type CO Boiler Burner Type B&W Spud

1. Test No.	11-4		11-4		11-4		11-4		11-4	
2. Date	9-8-76								→	
3. Time	1455		1500		1503		1506		1509	
4. Load Klb steam/hr	274		→		→		→		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	①		⑦		⑧		⑨		Comp.	
8. Oxygen (%)	2.1		2.1		2.2		1.9		2.0	
9. NOx (hot) read/3% O_2 (ppm)	115	110	+		+		+		+	
10. NO (hot) read/3% O_2 (ppm)	115	110	+		+		+		+	
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	+		+		+		+	
12. NO (cold) read/3% O_2 (ppm)	149	142	145	138	141	135	145	137	145	137
13. Carbon Dioxide (%)	14.4		13.6		13.6		13.6		13.6	
14. Carbon Monoxide (ppm) uncor/cor	38	36	32	31	30	29	28	26	32	30
15. Hydrocarbon (ppm) uncor/cor	10	10	+		+		+		+	
16. Sulfur Dioxide (ppm) uncor/cor	700	667	+		+		+		+	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	91		→		→		→		→	
19. Dew Point Temp. (°F/°C)	79		→		→		→		→	
20. Atmos. Pressure (in. Hg)	30.00		→		→		→		→	
21. Relative Humidity (%)	59		→		→		→		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

← Particulate & SO_x Tests →

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 11-5

Test No. 11-5 Date 9-9-76 Location 11 Engr. Wood

Unit No. 2 Fuel CO + Ref. Gas Capacity

Unit Type CO Boiler Burner Type B&W Spud

1. Test No.	11-5		11-5		11-5		11-5		11-5	
2. Date	9-9-76 →									
3. Time	0932		0935		0938		0941		0944	
4. Load Klb steam/hr	280 →									
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	1		7		8		9		COMP.	
8. Oxygen (%)	1.9		1.85		2.0		1.75		1.8	
9. NOx (hot) read/3% O_2 (ppm)	121	114	—		—		—		—	
10. NO (hot) read/3% O_2 (ppm)	120	113	—		—		—		—	
11. NO_2 (hot) read/3% O_2 (ppm)	1	1	—		—		—		—	
12. NO (cold) read/3% O_2 (ppm)	150	141	151	142	151	143	154	144	155	145
13. Carbon Dioxide (%)	13.9		13.1		13.6		13.6		13.6	
14. Carbon Monoxide (ppm) uncor/cor	60	57	88	83	64	61	52	49	56	52
15. Hydrocarbon (ppm) uncor/cor	5	5	—		—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor	780	735	—		—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/~~°C~~)	85 →									
19. Dew Point Temp. (°F/~~°C~~)	79 →									
20. Atmos. Pressure (in. Hg)	30.11 →									
21. Relative Humidity (%)	77 →									
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

← Baseline →

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 11-6

Test No. 11-6 Date 9-9-76 Location 11 Engr. Wood

Unit No. 2 Fuel Ref. Gas Capacity

Unit Type CO Boiler Burner Type B&W Spud

1. Test No.	11-6		11-6		11-6		11-6		11-6	
2. Date	9-9-76		→		→		→		→	
3. Time	1103		1108		1111		1114		1117	
4. Load K lb steam/hr	278		→		→		→		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	①		⑦		⑧		⑨		COMP.	
8. Oxygen (%)	2.4		2.3		2.5		2.0		2.1	
9. NOx (hot) read/3% O_2 (ppm)	116	112	—		—		—		—	
10. NO (hot) read/3% O_2 (ppm)	116	112	—		—		—		—	
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	—		—		—		—	
12. NO (cold) read/3% O_2 (ppm)	147	142	145	140	140	136	147	139	145	138
13. Carbon Dioxide (%)	13.6		14.0		13.6		14.4		14.0	
14. Carbon Monoxide (ppm) uncor/cor	28	27	36	35	32	31	38	36	40	38
15. Hydrocarbon (ppm) uncor/cor	10	10	—		—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor	700	677	—		—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	90		→		→		→		→	
19. Dew Point Temp. (°F/°C)	81		→		→		→		→	
20. Atmos. Pressure (in. Hg)	30.14		→		→		→		→	
21. Relative Humidity (%)	68		→		→		→		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

← NO_x Ports Open → Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 11-7, -8, -9

Test No. 11-7, -8, -9 Date 9-9-76 Location 11 Engr. Wood

Unit No. 2 Fuel CO+ Ref. Gas Capacity

Unit Type CO Boiler Burner Type B&W Spud

1. Test No.	11-7		11-8		11-9					
2. Date	9-9-76		9-9-76		9-9-76					
3. Time	1410		1450		1545					
4. Load K lb steam/hr	280		280		280					
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	1		1		1					
8. Oxygen (%)	1.6		1.95		1.8					
9. NOx (hot) read/3% O_2 (ppm)	120	111	118	112	125	117				
10. NO (hot) read/3% O_2 (ppm)	120	111	118	112	125	117				
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	0	0	0	0				
12. NO (cold) read/3% O_2 (ppm)	152	141	150	142	158	148				
13. Carbon Dioxide (%)	12		14.3		13.9					
14. Carbon Monoxide (ppm) uncor/cor	120 158	111 147	~160	~151	16	15				
15. Hydrocarbon (ppm) uncor/cor	5	5	10	10	10	9				
16. Sulfur Dioxide (ppm) uncor/cor	700	650	700	661	780	731				
17. Smoke Spot (Bacharach)	—		—		—					
18. Atmos. Temp. (°F/°C)	89		92		92					
19. Dew Point Temp. (°F/°C)	75		77		77					
20. Atmos. Pressure (in. Hg)	30.09		30.06		30.04					
21. Relative Humidity (%)	52		51		51					
22.										
23.										
24.	CO Spikes up To 240-400 ppm		CO Spikes From 120-200 ppm							
25.										
26.										
27.										
28.										
29.										
30.										
	NOx Ports Right Side 100% Open		NOx Ports, Right & Left Side 50% Open		Air Register Adj.- Burners 3&4					

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 11-10

Test No. 11-10 Date 9-10-76 Location 11 Engr. Wood

Unit No. 2 Fuel 50+ Ref. Gas Capacity

Unit Type CO Boiler Burner Type B&W Spud

1. Test No.	11-10		11-10		11-10		11-10		11-10	
2. Date	9-10-76		→		→		→		→	
3. Time	0755		0800		0803		0806		0809	
4. Load Klb steam/hr	280		→		→		→		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	①		②		③		④		Comp.	
8. Oxygen (%)	2.2		2.1		2.5		2.3		2.2	
9. NOx (hot) read/3% O_2 (ppm)	100	96	+		+		+		+	
10. NO (hot) read/3% O_2 (ppm)	100	96	+		+		+		+	
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	+		+		+		+	
12. NO (cold) read/3% O_2 (ppm)	122	117	118	112	114	111	114	110	114	109
13. Carbon Dioxide (%)	12.0		11.8		11.6		11.4		11.7	
14. Carbon Monoxide (ppm) uncor/cor	18	17	16	15	16	16	16	15	16	15
15. Hydrocarbon (ppm) uncor/cor	—	—	+		+		+		+	
16. Sulfur Dioxide (ppm) uncor/cor	440	421	+		+		+		+	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	76		→		→		→		→	
19. Dew Point Temp. (°F/°C)	72		→		→		→		→	
20. Atmos. Pressure (in. Hg)	30.08		→		→		→		→	
21. Relative Humidity (%)	82		→		→		→		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

← Baseline →

Data Sheet 6002-2

11-11, -12, -13

MOBILE LABORATORY DATA

Test No. -13

Test No. 11-11, -12, -13 Date 9-10-76 Location 11 Engr. Wood

Unit No. 2 Fuel CO + Ref. Gas Capacity

Unit Type CO Boiler Burner Type B & W Spud

1. Test No.	11-11		11-12		11-13							
2. Date	9-10-76		9-10-76		9-10-76							
3. Time	1005		1250		1320							
4. Load K lb steam/hr.	280		284		278							
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	①		①		①							
8. Oxygen (%)	1.95		2.45		2.55							
9. NOx (hot) read/3% O_2 (ppm)	112	106	125	121	121	118						
10. NO (hot) read/3% O_2 (ppm)	112	106	125	121	121	118						
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	0	0	0	0						
12. NO (cold) read/3% O_2 (ppm)	143	135	158	153	150	146						
13. Carbon Dioxide (%)	14.4		13.6		13.6							
14. Carbon Monoxide (ppm) uncor/cor	~70	66	8	8	~4	4						
15. Hydrocarbon (ppm) uncor/cor	5	5	4	4	4	4						
16. Sulfur Dioxide (ppm) uncor/cor	760	718	700	679	780	761						
17. Smoke Spot (Bacharach)	—		—		—							
18. Atmos. Temp. (°F/°C)	78		82		83							
19. Dew Point Temp. (°F/°C)	71		71		71							
20. Atmos. Pressure (in. Hg)	30.11		30.09		30.09							
21. Relative Humidity (%)	72		58		56							
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												
	#2 BOOS		#4 BOOS		Baseline							

Data Sheet 6002-2

OPERATING DATA
Location 11

FCCU CO BOILER

Test No.	11-1	11-2	11-3	11-4	11-5
Date	9-7-76	9-7-76	9-8-76	9-8-76	9-9-76
Time	1430	1520	1015	1500	0915
Test Type	Baseline	Low O_2	Baseline	Baseline	Baseline
Burner out of Service	None	None	None	None	None
B1 AR Position, notches open*	13	—	—	—	→
B2	13	—	—	—	→
B3	10	—	—	—	→
B4	12	—	—	—	→
NO_x Ports, leftside, % open	0	—	—	—	→
NO_x Ports, rightside, % open	0	—	—	—	→
Steam Flow (lbs/hr x 40,000)	7.55	7.75	6.95	6.85	7.15
Steam Drum Pressure (psig)	200	200	195	200	205
Steam Header Pressure (psig)	—	—	—	—	—
Feedwater Flow (lbs/hr x 40,000)	7.4	7.6	6.8	6.9	7.15
Boiler Blowdown (lbs/hr x 6,000)	8.05	8.2	7.9	7.9	8.2
Fuel Gas Flow (SCFM x 50,000)	4.1	4.1	3.75	3.82	3.91
Combustion Air (lbs/hr x 40,000)	8.5	8.55	8.2	8.0	8.5
Fuel Gas Header Pressure (psig)	47	46	45.5	46	46
Fuel Gas Burner Pressure (psig)	3	3	2.5	2.5	2.8
Pilot Gas Pressure (psig)	10+	10+	10+	10+	10+
F.D. Fan Discharge (in.)	17.4	17.2	16.2	16.2	16.8
Windbox Pressure (in.)	14.5	14.5	13.0	13.2	13.5
CO Duct Pressure (in.)	13.9	14.0	13.0	13.0	13.0
Furnace Pressure (in.)	14.0	14.0	12.9	12.9	13.0
Economizer Inlet Pressure (in.)	6.5	6.8	6.0	6.1	5.3
Economizer Outlet Pressure (in.)	0.0	0.0	0.0	0.0	0.0
BFW Pump Discharge Pressure (psig)	842	845	846	847	847
DeA FW Pump Pressure (psig)	90	90	91	91	90
Stack Opacity	26	30	27	25	28
Flue Gas O_2, % (Control Room)	1.95	1.4	1.95	2.0	1.85
Combustibles, %	0	0	0	0	0

* 19 notches is full open

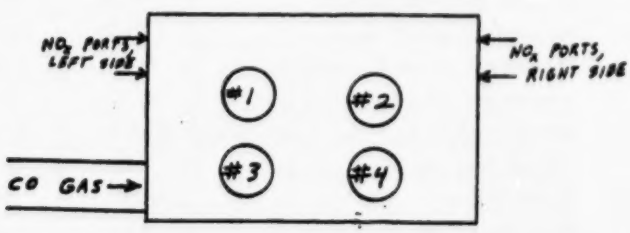
OPERATING DATA
Location 11

Sheet 2 of 2

FCCU CO BOILER

Test No.	11-1	11-2	11-3	11-4	11-5
Date	9-7-76	9-7-76	9-8-76	9-8-76	9-9-76
Time	1430	1520	1015	1500	0915
SH Steam Out (°F)	700	700	700	697	700
DeSH Steam Out (°F)	600	595	600	600	593
Economizer Gas Inlet (°F)	925	940	950	958	923
Economizer Gas Outlet (°F)	542	550	560	565	550
Economizer Water Inlet (°F)	255	258	250	250	260
Economizer Water Outlet (°F)	450	450	455	455	450
Ahead of Gen. Bank (°F)	1490	1520	1530	1528	1459
Flue Gas Exit (°F)	870	880	890	898	865
CO Gas Inlet (°F)	950	945	925	920	905
Steam Drum Steam Out (°F)	528	528	525	525	528
Furnace Temperature (°F)	1740	1775	1740	1740	1735
Barometric Pressure (in. Hg)	29.88	29.86	30.03	30.00	-
Relative Humidity (%)	54	60	74	59	-
Ambient Temperature (°F)	92	93	88	91	-
REGENERATOR DATA					
Lift Air Flow (lbs/hr)	125333	→			→
Combustion Air Flow (lbs/hr)	178000	178000	167400	170200	173000
Cyclone Steam (lbs/hr)	7560	7700	7280	Meter Out	7280
Cyclone Water (GPM)	0	→	→	→	→
Spray Water (GPM)	0	→	→	→	→

Comments:



OPERATING DATA
Location 11

Sheet 1 of 2

FCCU CO BOILER

Test No.	11-6	11-7	11-8	11-9	11-10*
Date	9-9-76	9-9-76	9-9-76	7-9-76	9-10-76
Time	1100	1410	1450	1545	0750
Test Type	O/S	O/S	O/S	AR Adj.	Baseline
Burner out of Service	None	None	None	None	None
B1 AR Position, notches open*	13	13	13	13	13
B2	13	13	13	13	13
B3	10	10	10	16	16
B4	12	12	12	16	16
NO_x Ports, leftside, % open	100	0	50	0	0
NO_x Ports, rightside, % open	0	100	50	0	0
Steam Flow (lbs/hr x 40,000)	6.95	7.05	7.0	7.0	7.1
Steam Drum Pressure (psig)	210	205	205	205	675
Steam Header Pressure (psig)	—	590	—	—	595
Feedwater Flow (lbs/hr x 40,000)	7.0	7.1	6.95	7.1	7.2
Boiler Blowdown (lbs/hr x 6,000)	8.2	8.2	8.1	8.1	8.25
Fuel Gas Flow (SCFH x 50,000)	3.9	3.9	3.8	3.8	4.05
Combustion Air (lbs/hr x 40,000)	8.6	8.7	8.3	8.2	8.3
Fuel Gas Header Pressure (psig)	45	46	45	47	44
Fuel Gas Burner Pressure (psig)	2.6	2.6	2.6	2.7	2.5
Pilot Gas Pressure (psig)	10+	10+	10+	10+	10+
F.D. Fan Discharge (in.)	15.7	—	15.2	15.0	15.0
Windbox Pressure (in.)	12.5	12.5	12.0	12.0	12.0
CO Duct Pressure (in.)	12.9	13	13	12.5	12.5
Furnace Pressure (in.)	12.9	13	13	12.5	12.5
Economizer Inlet Pressure (in.)	5.0	6	6	6	5
Economizer Outlet Pressure (in.)	0.0	0.0	0.0	0.0	0.0
BFW Pump Discharge Pressure (psig)	845	845	846	847	845
DeA FW Pump Pressure (psig)	90	91	91	91	91
Stack Opacity	28	30	25	27	24
Flue Gas O_2, % (Control Room)	2.3	2.1	2.2	1.75	2.1
Combustibles, %	0	0	0	0	0

* 19 notches is full open

+ Soot blowing occured during this period

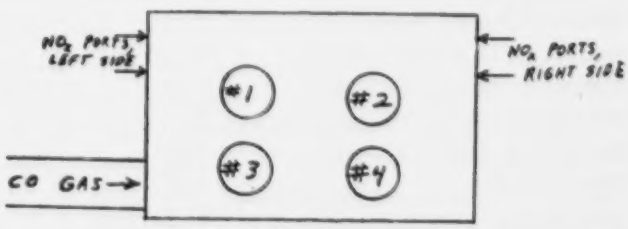
OPERATING DATA
Location 11

Sheet 2 of 2

FCCU CO BOILER

Test No.	11-6	11-7	11-8	11-9	11-10
Date	9-9-76	9-9-76	9-9-76	9-9-76	9-10-76
Time	1100	1410	1450	1545	0750
SH Steam Out (°F)	700	700	700	700	700
DeSH Steam Out (°F)	595	600	595	590	592
Economizer Gas Inlet (°F)	920	925	925	930	900
Economizer Gas Outlet (°F)	550	555	550	550	530
Economizer Water Inlet (°F)	257	260	255	255	260
Economizer Water Outlet (°F)	450	450	450	445	450
Ahead of Gen. Bank (°F)	1455	1435	1420	1490	1460
Flue Gas Exit (°F)	850	855	860	865	845
CO Gas Inlet (°F)	915	928	930	935	900
Steam Drum Steam Out (°F)	528	555	530	525	530
Furnace Temperature (°F)	1725	1675	1635	1750	1735
Barometric Pressure (in. Hg)	—	—	—	—	—
Relative Humidity (%)	—	—	—	—	—
Ambient Temperature (°F)	—	—	—	—	—
REGENERATOR DATA					
Lift Air Flow (lbs/hr)	125333	125333	125333	123405	124300
Combustion Air Flow (lbs/hr)	173000	174400	178400	173000	158500
Cyclone Steam (lbs/hr)	Meter Out	7400	8400	7560	7700
Cyclone Water (GPM)	0	0	0	0	0
Spray Water (GPM)	0	0	0	0	0

Comments:



OPERATING DATA
Location 11

Sheet 1 of 2

FCCU CO BOILER

Test No.	11-11	11-12	11-13		
Date	9-10-76	9-10-76	9-10-76		
Time	0950	1250	1320		
Test Type	O/S	O/S	Baseline		
Burner out of Service	#2	#4	None		
B1 AR Position, notches open*	13	13	13		
B2	13	13	13		
B3	16	16	16		
B4	16	16	16		
NO_x Ports, leftside, % open	0	0	0		
NO_x Ports, rightside, % open	0	0	0		
Steam Flow (lbs/hr x 40,000)	7.0	7.1	6.95		
Steam Drum Pressure (psig)	675	672	673		
Steam Header Pressure (psig)	595	594	594		
Feedwater Flow (lbs/hr x 40,000)	7.0	7.1	7.1		
Boiler Blowdown (lbs/hr x 6,000)	8.1	8.6	8.6		
Fuel Gas Flow (SCFM x 50,000)	4.0	4.0	4.0		
Combustion Air (lbs/hr x 40,000)	8.5	8.6	8.7		
Fuel Gas Header Pressure (psig)	45	45	46		
Fuel Gas Burner Pressure (psig)	4.5	4.5	2.9		
Pilot Gas Pressure (psig)	10+	10+	10+		
F.D. Fan Discharge (in.)	15.2	15.9	15.9		
Windbox Pressure (in.)	12.0	12.8	13.0		
CO Duct Pressure (in.)	12.5	13	12.9		
Furnace Pressure (in.)	12.5	13	13.0		
Economizer Inlet Pressure (in.)	5	5.9	5.9		
Economizer Outlet Pressure (in.)	0.0	0.0	0.0		
BFW Pump Discharge Pressure (psig)	846	846	846		
DeA FW Pump Pressure (psig)	91	91	91		
Stack Opacity	22	23	23		
Flue Gas O_2, % (Control Room)	2.45	2.0	2.5		
Combustibles, %	0	0	0		

* 19 notches is full open

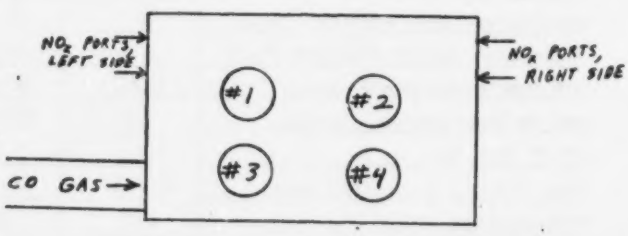
OPERATING DATA
Location 11

Sheet 2 of 2

FCCU CO BOILER

Test No.	11-11	11-12	11-13		
Date	9-10-76	9-10-76	9-10-76		
Time	0950	1250	1320		
SH Steam Out (°F)	700	700	700		
DeSH Steam Out (°F)	605	595	595		
Economizer Gas Inlet (°F)	890	905	900		
Economizer Gas Outlet (°F)	530	540	535		
Economizer Water Inlet (°F)	260	260	260		
Economizer Water Outlet (°F)	450	445	445		
Ahead of Gen. Bank (°F)	1400	1430	1440		
Flue Gas Exit (°F)	840	850	845		
CO Gas Inlet (°F)	910	910	910		
Steam Drum Steam Out (°F)	530	528	525		
Furnace Temperature (°F)	1645	1650	1730		
Barometric Pressure (in. Hg)	—	—	—		
Relative Humidity (%)	—	—	—		
Ambient Temperature (°F)	—	—	—		
REGENERATOR DATA					
Lift Air Flow (lbs/hr)	125333	→	→		
Combustion Air Flow (lbs/hr)	158500	160400	156100		
Cyclone Steam (lbs/hr)	7700	7700	7700		
Cyclone Water (GPM)	0	0	0		
Spray Water (GPM)	0	0	0		

Comments:



GASEOUS FUEL ANALYSIS

Test No 11-1

Test No 11-1 Date 9-7-76 Location 11 Engr

Unit No. 2 Fuel Composite* Fuel Sample No

Fuel Sample Point Fuel Analysis by Unit Owner

Gas		% Volume		CF air / CF fuel	Btu(HHV) / CF fuel	CF CO_2 / CF fuel	CF H_2O / CF fuel	CF Prod / CF fuel	lb Prod / CF fuel
CH_4	Methane	5.20	x	0.0955	9.94	0.01	0.02	0.1055	0.000416
C_2H_6	Ethane		x	0.1671	17.51	0.02	0.03	0.1821	0.000786
C_3H_8	Propane		x	0.2387	25.19	0.03	0.04	0.2587	0.001171
C_4H_{10}	Butane		x	0.3103	33.21	0.04	0.05	0.3353	0.001548
C_5H_{12}	Pentane		x	0.3819	41.11	0.05	0.06	0.4119	0.001864
C_2H_4	Ethylene		x	0.1432	15.80	0.02	0.02	0.1532	0.000726
C_3H_6	Propylene		x	0.2148	23.33	0.03	0.03	0.2298	0.001087
C_4H_8	Butylene		x	0.2869	31.23	0.04	0.04	0.3068	0.001449
C_5H_{10}	Pentylene		x	0.3580	39.16	0.05	0.05	0.3830	0.001813
C_2H_2	Acetylene		x	0.1193	14.57	0.02	0.01	0.1343	0.000682
C_6H_6	Benzene		x	0.3580	38.48	0.06	0.03	0.3730	0.002017
O_2	Oxygen	.76	x	-0.0477				-0.0377	0.000828
N_2	Nitrogen	78.7						0.01	0.000728
CO_2	Carb. Diox	8.9				0.01		0.01	0.001145
CO	Carb. Monox	9.4	x	0.0239	3.15	0.01		0.0289	0.000724
H_2	Hydrogen		x	0.0239	3.18		0.01	0.0289	0.0000522
H_2O	Water	.07							
	Total	100.0		0.758	81.3	235	.104	1.695	0.0749

Theoretical Air:

$\frac{SCF\ air}{10^6\ Btu} = \frac{CF\ air}{CF\ fuel} \times 10^6 / \frac{Btu(HHV)}{CF\ fuel} =$ $9.32 * 10^3$ SCF air/10^6 Btu @ 70°F, 29.92 in. Hg.

$\frac{WSCF\ Prod}{10^6\ Btu} = \frac{CF\ Prod}{CF\ fuel} \times 10^6 / \frac{Btu(HHV)}{CF\ fuel} =$ $2.08 * 10^4$ Wet SCF Prod/10^6 Btu

$\%\ Moisture = \frac{CF\ H_2O}{CF\ fuel} \times 100 / \frac{CF\ Prod}{CF\ fuel} =$ 6.14 $\%\ H_2O$

$\frac{DSCF\ Prod}{10^6\ Btu} = \frac{WSCF\ Prod}{10^6\ Btu} \times \frac{(100 - \%\ Moisture)}{100} =$ $1.95 * 10^4$ Dry SCF/10^6 Btu

$\%\ CO_2,\ dry = \frac{CF\ CO_2}{CF\ fuel} \times 100 / \left(\frac{CF\ Prod}{CF\ fuel} - \frac{CF\ H_2O}{CF\ fuel}\right) =$ 14.77 $\%\ CO_2$, dry

$K = \frac{*321.5 \times 10^6}{MW \times (DSCF/10^6\ Btu)}$

$K' = K/430$

$lb/10^6\ Btu = (ppm\ @\ 3\%\ O_2)/K$

$ng/J = (ppm\ @\ 3\%\ O_2)/K'$

MW	K for lb/10^6 Btu	K' for ng/J
NOx 46	$2.706 * 10^{-3}$	1.164
CO 28	$1.647 * 10^{-3}$	.708
HC 16	$9.412 * 10^{-4}$	.405
SOx 64	$3.765 * 10^{-3}$	1.619

* Composite of refinery gas & CO gas from regenerator

Data Sheet 6002-6 (Rev. 1)

GASEOUS FUEL ANALYSIS

Test No 11-1

Test No 11-1 Date 9-7-76 Location 11 Engr

Unit No. 2 Fuel Ref. Gas Fuel Sample No

Fuel Sample Point Fuel Analysis by Unit Owner

Gas		% Volume		CF air / CF fuel	Btu(HHV) / CF fuel	CF CO_2 / CF fuel	CF H_2O / CF fuel	CF Prod / CF fuel	lb Prod / CF fuel
CH_4	Methane	94.8	x	0.0955	9.94	0.01	0.02	0.1055	0.000416
C_2H_6	Ethane		x	0.1671	17.51	0.02	0.03	0.1821	0.000786
C_3H_8	Propane		x	0.2387	25.19	0.03	0.04	0.2587	0.001171
C_4H_{10}	Butane		x	0.3103	33.21	0.04	0.05	0.3353	0.001548
C_5H_{12}	Pentane		x	0.3819	41.11	0.05	0.06	0.4119	0.001864
C_2H_4	Ethylene		x	0.1432	15.80	0.02	0.02	0.1532	0.000726
C_3H_6	Propylene		x	0.2148	23.33	0.03	0.03	0.2298	0.001087
C_4H_8	Butylene		x	0.2869	31.23	0.04	0.04	0.3068	0.001449
C_5H_{10}	Pentylene		x	0.3580	39.16	0.05	0.05	0.3830	0.001813
C_2H_2	Acetylene		x	0.1193	14.57	0.02	0.01	0.1343	0.000682
C_6H_6	Benzene		x	0.3580	38.48	0.06	0.03	0.3730	0.002017
O_2	Oxygen		x	-0.0477				-0.0377	0.000828
N_2	Nitrogen	1.2						0.01	0.000728
CO_2	Carb. Diox	0.6				0.01		0.01	0.001145
CO	Carb. Monox	1.5	x	0.0239	3.15	0.01		0.0289	0.000724
H_2	Hydrogen	0.6	x	0.0239	3.18		0.01	0.0289	0.0000522
H_2O	Water	1.3							
	Total	100.0		9.104	948.9	0.969	1.915	10.093	0.0431

Theoretical Air:

$\frac{\text{SCF air}}{10^6 \text{ Btu}} = \frac{\text{CF air}}{\text{CF fuel}} \times 10^6 / \frac{\text{Btu(HHV)}}{\text{CF fuel}} = 9.594 \times 10^3$ SCF air/10^6 Btu @ 70°F, 29.92 in. Hg.

$\frac{\text{WSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{CF Prod}}{\text{CF fuel}} \times 10^6 / \frac{\text{Btu(HHV)}}{\text{CF fuel}} = 1.064 \times 10^4$ Wet SCF Prod/10^6 Btu

$\%\text{ Moisture} = \frac{\text{CF } H_2O}{\text{CF fuel}} \times 100 / \frac{\text{CF Prod}}{\text{CF fuel}} = 18.973$ $\%\ H_2O$

$\frac{\text{DSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{WSCF Prod}}{10^6 \text{ Btu}} \times \frac{(100 - \%\text{ Moisture})}{100} = 8.621 \times 10^3$ Dry SCF/10^6 Btu

$\%\ CO_2, \text{ dry} = \frac{\text{CF } CO_2}{\text{CF fuel}} \times 100 / \left(\frac{\text{CF Prod}}{\text{CF fuel}} - \frac{\text{CF } H_2O}{\text{CF fuel}}\right) = 11.849$ $\%\ CO_2$, dry

$K = \frac{= 331.5 \times 10^6}{MW \times (\text{DSCF}/10^6 \text{ Btu})}$

$K' = K/430$

$\text{lb}/10^6 \text{ Btu} = (\text{ppm @ 3\% } O_2)/K$

$\text{ng/J} = (\text{ppm @ 3\% } O_2)/K'$

	MW	K for lb/10^6 Btu	K' for ng/J
NOx	46	1.196×10^{-3}	.5144
CO	28	7.282×10^{-4}	.3131
HC	16	4.161×10^{-4}	.1789
SOx	64	1.664×10^{-3}	.7157

Data Sheet 6002-6 (Rev. 1)

GASEOUS FUEL ANALYSIS

Test No 11-1

Test No 11-1 Date 9-7-76 Location 11 Engr

Unit No. 2 Fuel CO Gas Fuel Sample No

Fuel Sample Point Regenerator Outlet Fuel Analysis by Unit Owner

Gas		% Volume		CF air / CF fuel	Btu(HHV) / CF fuel	CF CO_2 / CF fuel	CF H_2O / CF fuel	CF Prod / CF fuel	lb Prod / CF fuel
CH_4	Methane		x	0.0955	9.94	0.01	0.02	0.1055	0.000416
C_2H_6	Ethane		x	0.1671	17.51	0.02	0.03	0.1821	0.000786
C_3H_8	Propane		x	0.2387	25.19	0.03	0.04	0.2587	0.001171
C_4H_{10}	Butane		x	0.3103	33.21	0.04	0.05	0.3353	0.001548
C_5H_{12}	Pentane		x	0.3819	41.11	0.05	0.06	0.4119	0.001864
C_2H_4	Ethylene		x	0.1432	15.80	0.02	0.02	0.1532	0.000726
C_3H_6	Propylene		x	0.2148	23.33	0.03	0.03	0.2298	0.001087
C_4H_8	Butylene		x	0.2869	31.23	0.04	0.04	0.3068	0.001449
C_5H_{10}	Pentylene		x	0.3580	39.16	0.05	0.05	0.3830	0.001813
C_2H_2	Acetylene		x	0.1193	14.57	0.02	0.01	0.1343	0.000682
C_6H_6	Benzene		x	0.3580	38.48	0.06	0.03	0.3730	0.002017
O_2	Oxygen	0.8	x	-0.0477				-0.0377	0.000828
N_2	Nitrogen*	80.0						0.01	0.000728
CO_2	Carb. Diox	9.4				0.01		0.01	0.001145
CO	Carb. Monox	9.8	x	0.0239	3.15	0.01		0.0289	0.000724
H_2	Hydrogen		x	0.0239	3.18		0.01	0.0289	0.0000522
	Total	100.0		0.1961	30.9	0.192	0	1.1471	0.0768

Theoretical Air:

$$\frac{\text{SCF air}}{10^6 \text{ Btu}} = \frac{\text{CF air}}{\text{CF fuel}} \times 10^6 \Big/ \frac{\text{Btu(HHV)}}{\text{CF fuel}} = 6.346 \times 10^3 \text{ SCF air}/10^6 \text{ Btu @ 70°F, 29.92 in. Hg.}$$

$$\frac{\text{WSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{CF Prod}}{\text{CF fuel}} \times 10^6 \Big/ \frac{\text{Btu(HHV)}}{\text{CF fuel}} = 3.712 \times 10^4 \text{ Wet SCF Prod}/10^6 \text{ Btu}$$

$$\% \text{ Moisture} = \frac{\text{CF } H_2O}{\text{CF fuel}} \times 100 \Big/ \frac{\text{CF Prod}}{\text{CF fuel}} = 0 \ \%\ H_2O$$

$$\frac{\text{DSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{WSCF Prod}}{10^6 \text{ Btu}} \times \frac{(100 - \% \text{ Moisture})}{100} = 3.712 \times 10^4 \text{ Dry SCF}/10^6 \text{ Btu}$$

$$\%\ CO_2, \text{ dry} = \frac{\text{CF } CO_2}{\text{CF fuel}} \times 100 \Big/ \left(\frac{\text{CF Prod}}{\text{CF fuel}} - \frac{\text{CF } H_2O}{\text{CF fuel}}\right) = 16.74 \ \%\ CO_2, \text{ dry}$$

$$K = \frac{321.5 \times 10^6}{MW \times (\text{DSCF}/10^6 \text{ Btu})}$$

$K' = K/430$

$\text{lb}/10^6 \text{ Btu} = (\text{ppm @ 3\% } O_2)/K$

$\text{ng/J} = (\text{ppm @ 3\% } O_2)/K'$

	MW	K for lb/10^6 Btu	K' for ng/J
NOx	46	5.151×10^{-3}	2.215
CO	28	3.135×10^{-3}	1.348
HC	16	1.792×10^{-3}	.770
SOx	64	7.166×10^{-3}	3.082

*N_2 by difference

Data Sheet 6002-6 (Rev. 1)

PARTICULATE EMISSION CALCULATIONS

Test No. 11-3 Date 9-8-76 Location 11 Engr. Wood

Unit No. 2 Fuel CO + Ref. Gas Sampling Train and Method Method 5

Pitot Factor, Fs 0.84 Barometric Pressure, P_{bar} 30.0 in. Hg

Tot. Liquid Collected, V_{lc} 196.6 ml Total Particulate, M_n 246.4 m gm

Velocity Head, ΔP 0.189 Avg 0.23 at Sampling location in wg Stack Temp., Ts 1060 °R Stack Area, As 113.1 ft^2

Sample Volume, Vm 41.1 ft^3 Stack Press., Psg 0.15 iwg Excess O_2, EO_2 % 2.0 %

Orifice Press. Diff., H 1.275 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 45 min Nozzle Dia., Dn 3/8 in. Meter Temp., T_m — °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	41.31 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	9.32 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.184 N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	0.0919 grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	12.15×10^{-6} lb/DSCF
	c. C = Eq. 4b x 16.018×10^{3}	210.7×10^{-3} grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	408.15 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps}} \times \frac{1.00}{Gs}$	2279 at Sampling location (use for Iso Kin.) 2066 avg ft/min
7. Stack Gas Flow Rate @ 70°F	a. Qsv = Eq. 6 x As x $\frac{520}{Ts} \times \frac{Ps}{407}$	8655 WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	7062 DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	5.57 lb/hr
9. EO_2 factor	$EO_2f = 2090/(20.9 - EO_2\%)$	110.6 N.D.
10. Emission	a. E = Eq. 4b x Fs x Eq. 9	0.127 (using Fs = 87.4) lb/MBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	54670 (using Fm = .002346) ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	128 %

	Oil	Gas	Coal
Fs SC Feet/10^6 Btu	92.2	87.4	98.2
Fm SC Meters/10^6 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS

Test No. 11-3 Date 9-8-76 Location 11 Engr. Wood

Unit No. 2 Fuel Ref. Gas Sampling Train and Method Modified Method 5

Pitot Factor, Fs 0.84 Barometric Pressure, P_{bar} 30.0 in. Hg

Tot. Liquid Collected, V_{lc} 196.6 ml Total Particulate, M_n 263.7 m gm

Velocity Head, ΔP 0.189 avg (0.23 at sampling location) iwg Stack Temp., Ts 1060 °R Stack Area, As 113.1 ft^2

Sample Volume, Vm 41.1 ft^3 Stack Press., Psg 0.15 iwg Excess O_2, XO_2 % 2.0 %

Orifice Press. Diff., H 1.275 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 45 min Nozzle Dia., Dn 3/8 in. Meter Temp., T_m — °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	41.31	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	9.32	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.184	N.D.
4. Concentration a.	$C = 0.0154\ Mn/Vm_{std}$	0.098	grains/DSCF
b.	$C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	$14 * 10^{-6}$	lb/DSCF
c.	C = Eq. 4b x 16.018×10^3	$225 * 10^{-3}$	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	408.15	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	2279 at Sampling point 2066 avg.	ft/min
7. Stack Gas Flow Rate @ 70°F a.	Qsw = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	8655	WSCF/min
b.	Qsd = Eq. 7a x (1. - Eq. 3)	7062	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	5.93	lb/hr
9. XO_2 factor	$XO_2 f = 2090/(20.9 - XO_2\%)$	110.6	N.D.
10. Emission a.	E = Eq. 4b x Fe x Eq. 9	0.135 (using Fe = 87.4)	lb/MMBtu
b.	E = Eq. 4c x Fm x Eq. 9 x 1000	58380 (using Fm = 0.002346)	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	128	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$ (°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE CALCULATION SHEET

Test No. 11-3 Date 9-8-76 Location 11 Test Crew _____

Box No. 1 Sample Probe Position _____

Test Description _____

Dry Gas Meter Vol. (ft^3)

Final 5591.35

Initial 5550.25

Total 41.10

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final	278	100	3	654.4	
Initial	100	100	0	638.8	
Δ Vol	178	0	3	15.6	196.6

Beaker No. 1 & 6	2	3	H_2O Blank 200 ml 4	Acetone Blank 200 ml 5	Filter No. 8	Blank No. 9
Date Weighed 9-8-76				→	8-17-76	8-17-76
Tare Wt. 1 (1) 100.0929	101.6220	101.9823	99.2616	98.9338	.8557	.8020
Tare Wt. 1 (2) 100.0929	101.6222	101.9824	99.2615	98.9336	.8557	.8022
Tare Wt. 1 (3) 100.0929						
Tare Wt. 6 (4)						
Tare Wt. 6 (5) 100.4801						
Tare Wt. 6 (6) 100.4801						
Tare Wt. 6 Avg 100.4801	101.6221	101.9824	99.2616	98.9337	.8557	.8021
Bottle No. 1 & 2	3	4				
Content 1 Impinger (Water) 6	Probe (Acetone)	Probe (Water)	~~Cyclone (Acetone)~~	~~Flask (Dry)~~		
Rinse (ml) 200,100,100 / 200 / 100	200,25,175	200,150				
Date Weighed or 250 Bake 9-10-76						→
Final Wt. 250 1 (1) 100.1218	101.6303	101.9999	99.2620	98.9344	1.0294	.8018
Final Wt. 250 1 (2) 100.1219	101.6505	102.0001	99.2621	98.9346	1.0296	.8019
Final Wt. 250 1 (3) 100.1219					1.0298	
Final Wt. 650 6 (4)						
Final Wt. 650 6 (5) 100.4971						
Final Wt. 650 6 (6) 100.4972						
Final Wt. 650 6 Avg 100.4972	101.6504	102.0000	99.2621	98.9345	1.0296	.8019
Residue wt 1 = +.0290 / Final 250-Tare 6 = +.0171	+.0283	+.0176	+.0005	+.0008	+.1739	−.0002
Date Weighed or 650 Bake						
Final Wt. 650 1						
2						
3						
4						
5						
6						
Avg						
Residue Wt Final 650-Tare						

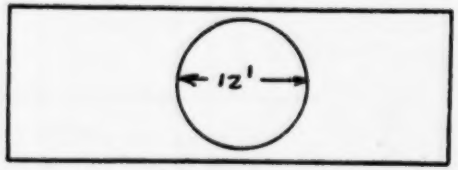
Comments:

Data Sheet 6002-3

Impinger catch = +.0290 + .0171 = +.0461

PLANT
LOCATION 11
OPERATOR
DATE 9-8-76
RUN NO. 11-3
SAMPLE BOX NO. 1
METER BOX NO. 2
METER H
C FACTOR

METHOD 5 CONTROL CONSOLE READINGS



SCHEMATIC OF STACK CROSS SECTION

AMBIENT TEMPERATURE 95 °F
BAROMETRIC PRESSURE
ASSUMED MOISTURE, %
HEATER BOX SETTING
PROBE LENGTH, IN. 48
NOZZLE DIAMETER, IN. 3/8
PROBE HEATER SETTING

Traverse Point Number	Sampling Time (θ) Min. Clock Time, Hr	Static Pressure (P_g), ~~In. Hg.~~ In H_2O	Stack Temperature (T_s) °F	Velocity Head (P_g) In. H_2O	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter: Inlet (T_{min}) °F	Gas Sample Temperature at Dry Gas Meter: Outlet (T_{mout}) °F	Sample Box Temperature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
	1443	0.15	600	2.3	1.5	5550.25		85	320	60
	1458	0.15	600	-	1.2	5567.00		95	300	75
	1513	0.15	600	-	1.2	5579.00		105	330	75
	1528	0.15	610	-	1.2	5591.35		110	360	75
TOTAL										
AVERAGE			602					AVG. AVG.		

Date 9-8-76

KVB, INC.

Test No. 11-4

SOx DATA SHEET

TEST NO. 11-4 UNIT NO. 2 FUEL Co+ 2.6. LOAD 274 klb/hr Location 11

Box No.	06	06			
Time	1320	1357			
Temp. in Gas Meter	102	96			
Press. in Gas Meter	0	0			
Meter Reading	5.630	8.250			
Barom. Press.	30.03	30.03			
Percent Oxygen	2.1	2.0			
N_2 Purge Time	1525	1545			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V\,(P + p)}$

Excess O_2 2.05 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	9.33	24.1	
B = Ml of lead perchlorate used for bland =	5.0	5.0	
N = Normality of lead perchlorate titrant =	.01987	.01987	
F = Dilution factor =	100	0	
T = Average temp. in gas meter °F =	99	99	
V = Volume of gas sample ft^3 =	2.62	2.62	
P = Barometric pressure =	30.03	30.03	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	1467	64	
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ $dscm/10^4$ cal

_____ $dscf/10^4$ Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 9-8-76

KVB, INC.

Test No. 11-4

SOx DATA SHEET

TEST NO. 11-4 UNIT NO. 2 FUEL C&T R.O. LOAD 274 klb/hr Location 11

Box No.	06	06			
Time	1406	1454			
Temp. in Gas Meter	102	96			
Press. in Gas Meter	0	0			
Meter Reading	9.298	11.643			
Barom. Press.	30.11	30.11			
Percent Oxygen	2.3	2.3			
N_2 Purge Time	1502	1527			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V\,(P + p)}$

Excess O_2 2.3 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	8.6	10.8	
B = Ml of lead perchlorate used for bland =	5.0	5.0	
N = Normality of lead perchlorate titrant =	.01987	.01987	
F = Dilution factor =	125	0	
T = Average temp. in gas meter °f =	99	99	
V = Volume of gas sample ft³ =	2.345	2.345	
P = Barometric pressure =	30.11	30.11	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	1699	22	
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^6 cal

_____ dscf/10^6 Btu

from Fed. Reg. 9/11/74 p 32856

80-14
rev. 1/2/75

PETROLEUM PROCESS HEATER

Location No. 12 Unit No. 1

Unit Description PETROLEUM PROCESS HEATER
VERTICAL FORCED DRAFT HEATER WITH AIR PREHEAT
3291 m^3/day (20.7 x 10^3 bbl/day)

Installation Date 1973

Heater Rating 27.5 MW (94 x 10^6 Btu/hr)

Burner Description COEN DAZ-83

Test Fuel Combinations REFINERY GAS
REFINERY GAS & No. 6 OIL (1.16% SULFUR)

Fuel Temp. at Burner (°F) No. 6 oil ~ 200°F

Primary Air Temp. (°F) 658 (725°F)

Comments:

MOBILE LABORATORY DATA Test No. _____

Test No. 12/1-1 Date 10-12-76 Location 12 Engr. W.C.

Unit No. 1 Fuel REF. GAS Capacity 67 x 10^6 BTU/HR

Unit Type VERTICAL PROCESS HEATER Burner Type COEN DAE-93

1. Test No.	12/1-1		12/1-1		12/1-1		12/1-1		12/1-1	
2. Date	10-12-76									
3. Time	10:15 AM		10:22		10:36		10:43		10:53	
4. Load										
5. Process Rate	29,700 #/hr									
6. Flue Diam. or Size, ft										
7. Probe Position	HOT LINE		STACK		PRE-HEAT IN		I.D. FAN OUT		HOT LINE	
8. Oxygen (%)	1.7		0.9		3.7		8.3		1.8	
9. NOx (hot) read/3% O_2 (ppm)	342	319	—	—	—	—	—	—	340	319
10. NO (hot) read/3% O_2 (ppm)	335	312	—	—	—	—	—	—	340	319
11. NO_2 (hot) read/3% O_2 (ppm)	7	7	—	—	—	—	—	—	0	0
12. NO (cold) read/3% O_2 (ppm)	—	—	187	167	170	177	215	305	—	—
13. Carbon Dioxide (%)	10.9		10.7		8.6		6.2		9.9	
14. Carbon Monoxide (ppm) uncor/cor	16	15	44	39	64	67	16	23	18	17
15. Hydrocarbon (ppm) uncor/cor	2	1.8	0	0	9	9	10	14	5	5
16. Sulfur Dioxide (ppm) uncor/cor	220	204	220	197	220	229	220	312	220	207
17. Smoke Spot (Bacharach)										
18. ~~Atmos. Temp.~~ (°F)/°C) DRY BULB	63									
19. Dew Point Temp. (°F/°C)	55									
20. Atmos. Pressure (in. Hg)	29.42									
21. Relative Humidity (%)	60									
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

BASELINE

Data Sheet 6002-2

BASELINE CHECK

MOBILE LABORATORY DATA Test No. _____

Test No. 12/1-2 Date 10/12/76 Location 12 Engr. BWH

Unit No. 1 Fuel REF. GAS Capacity 67 MM BTU/HR

Unit Type VERTICAL PROCESS HEATER Burner Type COEN DAZ-83

1. Test No.	12/1-2		12/1-2		12/1-2		12/1-2					
2. Date	10/12/76											
3. Time	11:45 AM		11:53		11:57		12:02 PM					
4. Load												
5. Process Rate	247K #/h											
6. Flue Diam. or Size, ft												
7. Probe Position	HOT LINE		STACK		PRE HEAT IN		ID FAN OUT					
8. Oxygen (%)	2.1		1.0		4.3		8.7					
9. NOx (hot) read/3% O_2 (ppm)	342	326	—	—	—	—	—	—				
10. NO (hot) read/3% O_2 (ppm)	335	319	—	—	—	—	—	—				
11. NO_2 (hot) read/3% O_2 (ppm)	7	7	—	—	—	—	—	—				
12. NO (cold) read/3% O_2 (ppm)	—	—	270	243	230	248	225	329				
13. Carbon Dioxide (%)	12.4		13.8		10.6		6.6					
14. Carbon Monoxide (ppm) uncor/cor	18	17	24	22	54	58	16	23				
15. Hydrocarbon (ppm) uncor/cor	4	4	2	2	0	0	4	6				
16. Sulfur Dioxide (ppm) uncor/cor	300	284	300	270	280	302	280	4/1				
17. Smoke Spot (Bacharach)												
18. ~~Atmos. Temp.~~ DRY BULB (°F/°C)							66					
19. Dew Point Temp. (°F/°C)							55					
20. Atmos. Pressure (in. Hg)							29.42					
21. Relative Humidity (%)							49					
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 12/1-3 Date 10/12/76 Location 12 Engr. BWH

Unit No. 1 Fuel REF. GAS Capacity _____

Unit Type _____ Burner Type _____

1. Test No.	12/1-3		12/1-3		12/1-3		12/1-3					
2. Date	10/12/76											
3. Time	1:07 PM		1:13 PM		1:18 PM							
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	HOT LINE-CONVECTIVE		STACK		PRE HEAT IN		ID FAN OUT					
8. Oxygen (%)	2.7		1.8		4.25		8.8					
9. NOx (hot) read/3% O_2 (ppm)	360	354	—	—	—	—	—	—				
10. NO (hot) read/3% O_2 (ppm)	355	349	—	—	—	—	—	—				
11. NO_2 (hot) read/3% O_2 (ppm)	5	5	—	—	—	—	—	—				
12. NO (cold) read/3% O_2 (ppm)	—	—	310	291	225	242	225					
13. Carbon Dioxide (%)	12.0		11.9		9.9		6.6					
14. Carbon Monoxide (ppm) uncor/cor	18	18	18	17	40	43	12					
15. Hydrocarbon (ppm) uncor/cor	5	5	2	2	1	1	1					
16. Sulfur Dioxide (ppm) uncor/cor	260	257	260	244	240	258	235					
17. Smoke Spot (Bacharach)												
18. ~~Atmos. Temp.~~ DRY BULB (°F/°C)	70											
19. Dew Point Temp. (°F/°C)	60											
20. Atmos. Pressure (in. Hg)	29.41											
21. Relative Humidity (%)	57											
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 12/1-4 Date 10/12/76 Location 12 Engr. BWH

Unit No. 1 Fuel REF. GAS Capacity _____

Unit Type _____ Burner Type _____

1. Test No.	12/1-4		12/1-4		12/1-4		12/1-4					
2. Date	10/12/76											
3. Time	1:59 PM		2:04		2:12		2:17					
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	HOT LINE #1		STACK #4		PRE HEAT IN #5		I.D. FAN OUT #6					
8. Oxygen (%)	3.1		2.1		4.55		9.0					
9. NOx (hot) read/3% O_2 (ppm)	369	371	—	—	—	—	—	—				
10. NO (hot) read/3% O_2 (ppm)	367	369	—	—	—	—	—	—				
11. NO_2 (hot) read/3% O_2 (ppm)	2	2	—	—	—	—	—	—				
12. NO (cold) read/3% O_2 (ppm)	—	—	322	307	272	298	230	345				
13. Carbon Dioxide (%)	11.0		11.9		10.6		7.2					
14. Carbon Monoxide (ppm) uncor/cor	16	16	28	27	40	44	12	18				
15. Hydrocarbon (ppm) uncor/cor	10	10	8	8	10	11	6	9				
16. Sulfur Dioxide (ppm) uncor/cor	140	141	140	133	100	110	100	150				
17. Smoke Spot (Bacharach)												
18. ~~Atmos. Temp.~~ DRY BULB (°F/°C)	69											
19. Dew Point Temp. (°F/°C)	58											
20. Atmos. Pressure (in. Hg)	29.41											
21. Relative Humidity (%)	51											
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 12/1-5 Date 10/13/76 Location 12 Engr. BWH

Unit No. 1 Fuel REF. GAS Capacity 67 MM BTU/HR

Unit Type VERTICAL PROCESS HEATER Burner Type COEN DAZ-83

1. Test No.	12/1-5		12/1-5		12/1-5		12/1-5			
2. Date	10/13/76									
3. Time	8:47 AM		9:00 AM		9:07 AM		9:12 AM			
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	#1		#4		#5		#6			
8. Oxygen (%)	2.2		1.15		4.1		8.2			
9. NOx (hot) read/3% O_2 (ppm)	310	297	—	—	—	—	—	—		
10. NO (hot) read/3% O_2 (ppm)	308	295	—	—	—	—	—	—		
11. NO_2 (hot) read/3% O_2 (ppm)	2	2	—	—	—	—	—	—		
12. NO (cold) read/3% O_2 (ppm)	—	—	290	263	230	245	197	277		
13. Carbon Dioxide (%)	10.2		12.2		9.6		6.4			
14. Carbon Monoxide (ppm) uncor/cor	8	8	16	15	20	21	4	6		
15. Hydrocarbon (ppm) uncor/cor	—	—	2	2	0	0	0	0		
16. Sulfur Dioxide (ppm) uncor/cor	62	59	70	63	104	111	116	163		
17. Smoke Spot (Bacharach)										
18. ~~Atmos. Temp.~~ DRY BULB (°F/°C)					54					
19. Dew Point Temp. (°F/°C)					45					
20. Atmos. Pressure (in. Hg)					29.71					
21. Relative Humidity (%)					49					
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 12/1-6 Date 10/13/76 Location 12 Engr. BWH

Unit No. 1 Fuel REF. GAS Capacity 67 MM BTU/HR

Unit Type_____ Burner Type_____

1. Test No.	12/1-6		12/1-6		12/1-6		12/1-6					
2. Date	10/13/76											
3. Time	10:05 AM		10:17 AM		10:24 AM							
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	#1 HOT		#4 STACK		#5 IN		#6 OUT					
8. Oxygen (%)	1.3		0.35		3.6		8.15					
9. NOx (hot) read/3% O_2 (ppm)	270											
10. NO (hot) read/3% O_2 (ppm)	275											
11. NO_2 (hot) read/3% O_2 (ppm)	0											
12. NO (cold) read/3% O_2 (ppm)	350	320	325	283	290	300	230	322				
13. Carbon Dioxide (%)	11.3		11.6		9.9		7.4					
14. Carbon Monoxide (ppm) uncor/cor	48	44	260	227	52	54	40	56				
15. Hydrocarbon (ppm) uncor/cor												
16. Sulfur Dioxide (ppm) uncor/cor	100	91	60	52	60	62	40	56				
17. Smoke Spot (Bacharach)												
18. Atmos. Temp. (°F/°C)												
19. Dew Point Temp. (°F/°C)												
20. Atmos. Pressure (in. Hg)												
21. Relative Humidity (%)												
22.			CO WAS									
23.			SPIKING FROM									
24.			120 PPM TO									
25.			OVER 400 PPM									
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 12/1-7 Date 10/13/76 Location 12 Engr. BWH

Unit No. 1 Fuel REF. GAS Capacity 67 MM BTU/HR

Unit Type VERTICAL PROCESS HEATER Burner Type COEN DAB-83

1. Test No.	12/1-7		12/1-7		12/1-7		12/1-7		12/1-7	
2. Date	10/13/76									
3. Time										
4. Load	2:25 PM		2:30 PM		2:35 PM		2:40 PM		2:47 PM	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	#1 HOT		#4 STACK		#5 IN		#6 OUT		#1 HOT	
8. Oxygen (%)	2.2		1.3		4.0		8.5		2.2	
9. NOx (hot) read/3% O_2 (ppm)	292	280	—	—	—	—	—	—	300	287
10. NO (hot) read/3% O_2 (ppm)	295	282	—	—	—	—	—	—	295	282
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	—	—	—	—	—	—	5	5
12. NO (cold) read/3% O_2 (ppm)	340	371	365	336	310	328	250	360	385	368
13. Carbon Dioxide (%)	10.6		10.6		9.2		6.5		10.6	
14. Carbon Monoxide (ppm) uncor/cor	28	27	30	27	36	38	24	35	28	27
15. Hydrocarbon (ppm) uncor/cor										
16. Sulfur Dioxide (ppm) uncor/cor	10	10	10	9	10	11	10	14	10	10
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)										
19. Dew Point Temp. (°F/°C)										
20. Atmos. Pressure (in. Hg)			29.64							
21. Relative Humidity (%)										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 12/1-8 Date 10-14-76 Location 12 Engr. WC

Unit No. 1 Fuel NO. 6 OIL Capacity_____

Unit Type_____ Burner Type_____

1. Test No.	12/1-8		12/1-8		12/1-8		12/1-8		12/1-8	
2. Date	10-14-76									
3. Time	9:30 AM		9:40 AM		9:50 AM					
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	#1 HOT		#4 STACK		#5 IN		#6 OUT		#1 HOT	
8. Oxygen (%)	3.2		3.6		5.2		9.0		3.3	
9. NOx (hot) read/3% O_2 (ppm)	210	212	—	—	—	—	—	—	209	213
10. NO (hot) read/3% O_2 (ppm)	210	212	—	—	—	—	—	—	205	208
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	—	—	—	—	—	—	4	5
12. NO (cold) read/3% O_2 (ppm)	260	260	225	233	205	234	150	225	218	222
13. Carbon Dioxide (%)	12.4		11.8		11.3		8.3		12.8	
14. Carbon Monoxide (ppm) uncor/cor	28	28	40	41	46	52	32	48	34	35
15. Hydrocarbon (ppm) uncor/cor										
16. Sulfur Dioxide (ppm) uncor/cor			360	372	320	365	320	480	340	346
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)										
19. Dew Point Temp. (°F/°C)										
20. Atmos. Pressure (in. Hg)					29.14					
21. Relative Humidity (%)										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 12/1-9 Date 10/14/76 Location 12 Engr. BWH

Unit No. 1 Fuel #6 OIL Capacity 67 MM BTU/HR

Unit Type _____ Burner Type _____

1. Test No.	12/1-9		12/1-9		12/1-9		12/1-9					
2. Date	10/14/76											
3. Time	10.25AM		10:30		10:37		10:43					
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	#1 HOT		#4 STACK		#5 IN		#6 OUT					
8. Oxygen (%)	2.2		2.1		3.9		7.8					
9. NOx (hot) read/3% O_2 (ppm)	205	196	—	—	—	—	—	—				
10. NO (hot) read/3% O_2 (ppm)	205	196	—	—	—	—	—	—				
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	—	—	—	—	—	—				
12. NO (cold) read/3% O_2 (ppm)	245	235	200	191	200	211	160	218				
13. Carbon Dioxide (%)	13.2		13.6		12.8		9.4					
14. Carbon Monoxide (ppm) uncor/cor	28	27	32	30	36	38	27	37				
15. Hydrocarbon (ppm) uncor/cor												
16. Sulfur Dioxide (ppm) uncor/cor	380	364	400	381	460	484	520	709				
17. Smoke Spot (Bacharach)												
18. ~~Atmos. Temp.~~ DRY BULB (°F/°C)	67											
19. Dew Point Temp. (°F/°C)	54											
20. Atmos. Pressure (in. Hg)	29.10											
21. Relative Humidity (%)	41											
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 12/1-10 Date 10/14/76 Location 12 Engr. BWH

Unit No. 1 Fuel #6 OIL Capacity 67 MM BTU/HR

Unit Type _____ Burner Type _____

1. Test No.	12/1-10		12/1-10		12/1-10		12/1-10					
2. Date	10/14/76											
3. Time	11:07 AM		11:12 AM		11:17 AM		11:21 AM					
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	#1 HOT		#4 STACK		#5 IN		#6 OUT					
8. Oxygen (%)	1.5		1.85		3.3		7.6					
9. NOx (hot) read/3% O2 (ppm)	200	195	—	—	—	—	—	—				
10. NO (hot) read/3% O2 (ppm)	198	183	—	—	—	—	—	—				
11. NO_2 (hot) read/3% O2 (ppm)	2	2	—	—	—	—	—	—				
12. NO (cold) read/3% O2 (ppm)	240	222	200	188	248	252	192	258				
13. Carbon Dioxide (%)	14.0		13.4		12.0		8.9					
14. Carbon Monoxide (ppm) uncor/cor	34	31	33	31	36	37	28	38				
15. Hydrocarbon (ppm) uncor/cor												
16. Sulfur Dioxide (ppm) uncor/cor	410	425			200	203	240	322				
17. Smoke Spot (Bacharach)	3											
18. Atmos. Temp. (°F/°C) DRY BULB	71											
19. Dew Point Temp. (°F/°C)	59											
20. Atmos. Pressure (in. Hg)	29.08											
21. Relative Humidity (%)	50											
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 12/1-11 Date 10/14/76 Location 12 Engr. BWH

Unit No. 1 Fuel #6 OIL Capacity 67 MM BTU/HR

Unit Type _____ Burner Type _____

1. Test No.	12/1-11		12/1-11		12/1-11		12/1-11					
2. Date	10/14/76											
3. Time	11:48 AM		11:53		11:58		12:05 PM					
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	#1 HOT		#4 STACK		#5 IN		#6 OUT					
8. Oxygen (%)	1.9		2.2		4.1		8.3					
9. NOx (hot) read/3% O_2 (ppm)	235	221	—	—	—	—	—	—				
10. NO (hot) read/3% O_2 (ppm)	220	207	—	—	—	—	—	—				
11. NO_2 (hot) read/3% O_2 (ppm)	15	14	—	—	—	—	—	—				
12. NO (cold) read/3% O_2 (ppm)	275	259	230	220	215	229	170	241				
13. Carbon Dioxide (%)	13.6		13.6		12.0		9.8					
14. Carbon Monoxide (ppm) uncor/cor	36	34	36	34	40	43	32	45				
15. Hydrocarbon (ppm) uncor/cor												
16. Sulfur Dioxide (ppm) uncor/cor	400	377	470	450	500	533	520	737				
17. Smoke Spot (Bacharach)												
18. ~~Atmos. Temp.~~ DRY BULB (°F) °C)	72											
19. Dew Point Temp. (°F) °C)	59											
20. Atmos. Pressure (in. Hg)	29.08											
21. Relative Humidity (%)	47											
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

CONTROL ROOM DATA
Location 12
Unit 1

FCC CHARGE HYDROTREATER Data Taken By WAC

Test No.	12/1-1	12/1-2	12/1-3	12/1-4	
Date	10-12-76	10-12-76	10-12-76	10-12-76	
Time	1010	1145	1305	1440	
Charge Oil Flow x 700 B/D					
Pass 1	7.4	7.4	7.4	7.4	
Pass 2	7.4	7.4	7.4	7.4	
Pass 3	7.4	7.4	7.4	7.4	
Pass 4	7.4	7.4	7.4	7.4	
Hydrogen Flow to Heater x 2,500,000 SCFD					
Pass 5	7.55	7.65	7.35	7.2	
Pass 6	7.6	7.60	7.25	7.1	
Pass 7	7.5	7.55	7.20	7.0	
Pass 8	7.55	7.75	7.45	7.3	
Fuel Flow to Heater x 3 MM SCFD	.6	.59	.60	0.61	
Fuel Oil Flow to Heater x 80 B/D	—	—	—		
Oxygen Analyzer (% O_2)	1.7%	2.0%	2.6%	2.7%	
Temperatures (°F)					
Charge Temperature	393	397	404	401	
Heater Radiant Section	1269	1269	1280	1292	
Flue Gas Duct to Air Heater	1187	1178	1170	1176	
ID Fan Outlet	254	256	257	253	
Convection Section	1682	1675	1665	1658	
Arch Section	1298	1284	1276	1280	
Combustion Air Inlet	700	698	690	685	
Draft Gauges					
Windbox Pressure, in. H_2O	4.0	4.0	4.0	4.3	
Stack .					
Convection Top	-0.13	-0.12	-0.10	-0.60	
Convection Bottom	-0.40	-0.45	-0.21	-0.23	
ID Fan Outlet					
Firebox Vacuum, in. H_2O	-0.25	-0.26	-0.25	-0.20	
Preheater Inlet, in. H_2O					
Fuel Gas Inlet, psig	51	53	52	53	
Fuel Oil Inlet, psig	—	—	—		
REACTOR INLET (°F)	676	677	676	678	

CONTROL ROOM DATA
Location 12
Unit 1

FCC CHARGE HYDROTREATER Data Taken By NC

Test No.	12/1-5	12/1-6			
Date	10-13-76	10-13-76			
Time	0847	1005			
Charge Oil Flow x 700 B/D					
Pass 1	7.4	7.4			
Pass 2	7.4	7.4			
Pass 3	7.4	7.4			
Pass 4	7.4	7.4			
Hydrogen Flow to Heater x 2,500,000 SCFD					
Pass 5	7.0	7.0			
Pass 6	7.0	7.0			
Pass 7	6.7	6.7			
Pass 8	7.1	7.1			
Fuel Flow to Heater x 3 MM SCFD	.62	.72			
Fuel Oil Flow to Heater x 80 B/D	—	—			
Oxygen Analyzer (% O_2)	2.4	1.8			
Temperatures (°F)					
Charge Temperature	396	395			
Heater Radiant Section	1290	1279			
Flue Gas Duct to Air Heater	1154	1154			
ID Fan Outlet	250	261			
Convection Section	1668	1686			
Arch Section	1262	1258			
Combustion Air Inlet	690	700			
Draft Gauges					
Windbox Pressure, in. H_2O	3.5	3.1			
Stack .					
Convection Top	-0.1	-.23			
Convection Bottom	-0.25	-.41			
ID Fan Outlet					
Firebox Vacuum, in. H_2O	-0.36	-.44			
Preheater Inlet, in. H_2O					
Fuel Gas Inlet, psig	50	51			
Fuel Oil Inlet, psig	—				

CONTROL ROOM DATA
Location 12
Unit 1

FCC CHARGE HYDROTREATER Data Taken By WC

Test No.	12/1-8	12/1-9	12/1-10	12/1-11	12/1-12
Date	10-14-76	10-14-76	10-14-76	10-14-76	10-14-76
Time	0955	1030	1103	1145	1530
Charge Oil Flow x 700 B/D					
Pass 1	7.4	7.4	7.4	7.4	7.4
Pass 2	7.4	7.4	7.4	7.4	7.4
Pass 3	7.4	7.4	7.4	7.4	7.4
Pass 4	7.4	7.4	7.4	7.4	7.4
Hydrogen Flow to Heater x 2,500,000 SCFD					
Pass 5	6.8	6.8	6.85	6.9	6.8
Pass 6	6.9	6.95	7.0	7.0	6.85
Pass 7	6.85	6.85	6.9	6.9	6.8
Pass 8	6.8	6.8	6.8	6.8	7.0
Fuel Flow to Heater x 3 MM SCFD	.2	.2	<.1	.15	.1
Fuel Oil Flow to Heater x 80 B/D	6.6	6.6	6.6	6.5	6.5
Oxygen Analyzer (% O_2)	2.8	1.7	1.5	1.5	2.2
Temperatures (°F)					
Charge Temperature	399	396	399	398	400
Heater Radiant Section	1495	1508	1497	1498	1498
Flue Gas Duct to Air Heater	1116	1095	1070	1088	1067
ID Fan Outlet	243	257	266	267	261
Convection Section	1534	1534	1498	1530	1480
Arch Section	1217	1194	1164	1191	1164
Combustion Air Inlet	665	675	670	675	660
Draft Gauges					
Windbox Pressure, in. H_2O	4.1	3.4	3.0	3.4	3.4
Stack					
Convection Top					
Convection Bottom					
ID Fan Outlet					
Firebox Vacuum, in. H_2O					
Preheater Inlet, in. H_2O					
Fuel Gas Inlet, psig	55	51	55	55	55
Fuel Oil Inlet, psig	84	82	83	83	82

LOCATION 12

UNIT 1

FUEL OIL ANALYSIS

Test 12/1-8

November 14, 1976

Carbon, %	87.37
Hydrogen, %	10.30
Nitrogen, %	0.27
Sulfur, %	1.16
Ash, %	0.044
Oxygen, % (by difference)	0.86
API Gravity at 60°F	12.7
Heat of Combustion:	
Gross BTU/lb.	18,450
Net BTU/lb.	17,510

GASEOUS FUEL ANALYSIS

Test No _____

Test No 12/1-1T04 Date 10-14-76 Location 12 Engr WAC

Unit No. 1 Fuel REF. GAS Fuel Sample No _____

Fuel Sample Point FUEL GAS DRUM Fuel Analysis by _____

Gas		% Volume		CF air / CF fuel	Btu(HHV) / CF fuel	CF CO_2 / CF fuel	CF H_2O / CF fuel	CF Prod / CF fuel	lb Prod / CF fuel
CH_4	Methane	50.8	x	0.0955	9.94	0.01	0.02	0.1055	0.000416
C_2H_6	Ethane	23.6	x	0.1671	17.51	0.02	0.03	0.1821	0.000786
C_3H_8	Propane	7.1	x	0.2387	25.19	0.03	0.04	0.2587	0.001171
C_4H_{10}	Butane	1.4	x	0.3103	33.21	0.04	0.05	0.3353	0.001548
C_5H_{12}	Pentane		x	0.3819	41.11	0.05	0.06	0.4119	0.001864
C_2H_4	Ethylene		x	0.1432	15.80	0.02	0.02	0.1532	0.000726
C_3H_6	Propylene	1.2	x	0.2148	23.33	0.03	0.03	0.2298	0.001087
C_4H_8	Butylene	1.3	x	0.2869	31.23	0.04	0.04	0.3068	0.001449
C_5H_{10}	Pentylene		x	0.3580	39.16	0.05	0.05	0.3830	0.001813
C_2H_2	Acetylene		x	0.1193	14.57	0.02	0.01	0.1343	0.000682
C_6H_6	Benzene		x	0.3580	38.48	0.06	0.03	0.3730	0.002017
O_2	Oxygen		x	-0.0477				-0.0377	0.000828
N_2	Nitrogen							0.01	0.000728
CO_2	Carb. Diox					0.01		0.01	0.001145
CO	Carb. Monox		x	0.0239	3.15	0.01		0.0289	0.000724
H_2	Hydrogen	14.6	x	0.0239	3.18		0.01	0.0289	0.0000522
	Total	100.00		11.904	1258.6	1.337	2.312	15.060	0.0541

Theoretical Air:

$$\frac{\text{SCF air}}{10^6 \text{ Btu}} = \frac{\text{CF air}}{\text{CF fuel}} \times 10^6 \Big/ \frac{\text{Btu(HHV)}}{\text{CF fuel}} = 9.458 \times 10^3 \text{ SCF air}/10^6 \text{ Btu @ 70°F, 29.92 in. Hg.}$$

$$\frac{\text{WSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{CF Prod}}{\text{CF fuel}} \times 10^6 \Big/ \frac{\text{Btu(HHV)}}{\text{CF fuel}} = 1.038 \times 10^4 \text{ Wet SCF Prod}/10^6 \text{ Btu}$$

$$\% \text{ Moisture} = \frac{\text{CF } H_2O}{\text{CF fuel}} \times 100 \Big/ \frac{\text{CF Prod}}{\text{CF fuel}} = 17.7 \ \% H_2O$$

$$\frac{\text{DSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{WSCF Prod}}{10^6 \text{ Btu}} \times \frac{(100 - \% \text{ Moisture})}{100} = 8543 \text{ Dry SCF}/10^6 \text{ Btu}$$

$$\% CO_2, \text{ dry} = \frac{\text{CF } CO_2}{\text{CF fuel}} \times 100 \Big/ \left(\frac{\text{CF Prod}}{\text{CF fuel}} - \frac{\text{CF } H_2O}{\text{CF fuel}}\right) = 12.44 \ \% CO_2, \text{ dry}$$

$$K = \frac{331.5 \times 10^6}{MW \times (\text{DSCF}/10^6 \text{ Btu})}$$

$K' = K/430$

$\text{lb}/10^6 \text{ Btu} = (\text{ppm @ 3\% } O_2)/K$

$\text{ng/J} = (\text{ppm @ 3\% } O_2)/K'$

	MW	K for lb/10^6 Btu	K' for ng/J
NOx	46	843.9	1.962
CO	28	1386	3.223
HC	16	2425	5.640
SOx	64	606.4	1.410

Data Sheet 6002-6 (Rev. 1)

GASEOUS FUEL ANALYSIS

Test No _____

Test No 12/1-1 to 4 Date 10-12-76 Location 12 Engr W. CARTER

Unit No. 1 Fuel REF. GAS Fuel Sample No _____

Fuel Sample Point FUEL GAS DRUM Fuel Analysis by _____

Gas		% Volume		CF air / CF fuel	Btu(HHV) / CF fuel	CF CO_2 / CF fuel	CF H_2O / CF fuel	CF Prod / CF fuel	lb Prod / CF fuel
CH_4	Methane	64.3	x	0.0955	9.94	0.01	0.02	0.1055	0.000416
C_2H_6	Ethane	24.0	x	0.1671	17.51	0.02	0.03	0.1821	0.000786
C_3H_8	Propane	7.4	x	0.2387	25.19	0.03	0.04	0.2587	0.001171
C_4H_{10}	Butane	1.5	x	0.3103	33.21	0.04	0.05	0.3353	0.001548
C_5H_{12}	Pentane		x	0.3819	41.11	0.05	0.06	0.4119	0.001864
C_2H_4	Ethylene		x	0.1432	15.80	0.02	0.02	0.1532	0.000726
C_3H_6	Propylene	1.3	x	0.2148	23.33	0.03	0.03	0.2298	0.001087
C_4H_8	Butylene	1.5	x	0.2869	31.23	0.04	0.04	0.3068	0.001449
C_5H_{10}	Pentylene		x	0.3580	39.16	0.05	0.05	0.3830	0.001813
C_2H_2	Acetylene		x	0.1193	14.57	0.02	0.01	0.1343	0.000682
C_6H_6	Benzene		x	0.3580	38.48	0.06	0.03	0.3730	0.002017
O_2	Oxygen		x	-0.0477				-0.0377	0.000828
N_2	Nitrogen							0.01	0.000728
CO_2	Carb. Diox					0.01		0.01	0.001145
CO	Carb. Monox		x	0.0239	3.15	0.01		0.0289	0.000724
H_2	Hydrogen		x	0.0239	3.18		0.01	0.0289	0.0000522
	Total	100.0		13.092	1372.8	1.504	2.476	14.330	0.0602

Theoretical Air:

$$\frac{\text{SCF air}}{10^6 \text{ Btu}} = \frac{\text{CF air}}{\text{CF fuel}} \times 10^6 \Big/ \frac{\text{Btu(HHV)}}{\text{CF fuel}} = 9.537 \times 10^3 \text{ SCF air}/10^6 \text{ Btu @ 70°F, 29.92 in. Hg.}$$

$$\frac{\text{WSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{CF Prod}}{\text{CF fuel}} \times 10^6 \Big/ \frac{\text{Btu(HHV)}}{\text{CF fuel}} = 1.044 \times 10^4 \text{ Wet SCF Prod}/10^6 \text{ Btu}$$

$$\% \text{ Moisture} = \frac{\text{CF } H_2O}{\text{CF fuel}} \times 100 \Big/ \frac{\text{CF Prod}}{\text{CF fuel}} = 17.28 \ \%\ H_2O$$

$$\frac{\text{DSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{WSCF Prod}}{10^6 \text{ Btu}} \times \frac{(100 - \% \text{ Moisture})}{100} = 8.636 \times 10^3 \text{ Dry SCF}/10^6 \text{ Btu}$$

$$\%\ CO_2, \text{ dry} = \frac{\text{CF } CO_2}{\text{CF fuel}} \times 100 \Big/ \left(\frac{\text{CF Prod}}{\text{CF fuel}} - \frac{\text{CF } H_2O}{\text{CF fuel}}\right) = 12.69 \ \%\ CO_2, \text{ dry}$$

$$K = \frac{331.5 \times 10^6}{MW \times (\text{DSCF}/10^6 \text{ Btu})}$$

$K' = K/430$

$\text{lb}/10^6 \text{ Btu} = (\text{ppm @ 3\% } O_2)/K$

$\text{ng/J} = (\text{ppm @ 3\% } O_2)/K'$

	MW	K for lb/10^6 Btu	K' for ng/J
NOx	46	834.7	1.94
CO	28	1371	3.19
HC	16	2399	5.57
SOx	64	622.3	1.40

Data Sheet 6002-6 (Rev. 1)

Date 14 OCT '76

KVB, INC.

Test No. 12/1-12

SOx DATA SHEET

TEST NO. 12/1-12 UNIT NO. ____ FUEL #2 OIL LOAD ____ klb/hr ____ Location 12

Box No.	1	1			
Time	1315	1334			
Temp. in Gas Meter	120	120			
Press. in Gas Meter	0	0			
Meter Reading	0	1.000			
Barom. Press.	29.4	29.4			
Percent Oxygen	2.3	2.3			
N_2 Purge Time	1341	1408			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V\,(P + p)}$

Excess O_2 2.3 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	14.6	—	
B = Ml of lead perchlorate used for bland =	5.0	—	
N = Normality of lead perchlorate titrant =	.0178		
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	580		
V = Volume of gas sample ft^3 =	1.000		
P = Barometric pressure =	29.4		
p = Pressure in gas meter =	0		
Concentration, C, ppm =	809	—	
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 14 OCT '76

KVB, INC.

Test No. 12/1-12

SOx DATA SHEET

TEST NO. 12/1-10 UNIT NO. ____ FUEL #6014 LOAD ____ klb/hr ____ Location 12

Box No.	2	2			
Time	1354	1406			
Temp. in Gas Meter	120	119			
Press. in Gas Meter	0	0			
Meter Reading	0	1.000			
Barom. Press.	29.4	29.4			
Percent Oxygen	1.9	1.9			
N_2 Purge Time	1412	1442			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V (P + p)}$

Excess O_2 1.9 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	14.8	—	
B = Ml of lead perchlorate used for bland =	5.0		
N = Normality of lead perchlorate titrant =	.0178		
F = Dilution factor =	10		
T = Average temp. in gas meter =	580		
V = Volume of gas sample ft3 =	1.000		
P = Barometric pressure =	29.4		
p = Pressure in gas meter =	0		
Concentration, C, ppm =	826		
,ym/dscm =			
Emission ,E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 14 OCT '76

K V B, INC.

Test No. 12/1-12

SOx DATA SHEET

TEST NO. 12/1-12 UNIT NO. ____ FUEL #2 OIL LOAD ____ klb/hr ____ Location 12

Box No.	1	1			
Time	1430	1441			
Temp. in Gas Meter	118	118			
Press. in Gas Meter	0	0			
Meter Reading	0	1.000			
Barom. Press.	29.4	29.4			
Percent Oxygen	2.4	2.4			
N_2 Purge Time	1445	1510			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V\,(P + p)}$

Excess O_2 2.4 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	14.5	—	
B = Ml of lead perchlorate used for bland =	5.0		
N = Normality of lead perchlorate titrant =	.0178		
F = Dilution factor =	10		
T = Average temp. in gas meter =	578		
V = Volume of gas sample ft^3 =	1.000		
P = Barometric pressure =	29.4		
p = Pressure in gas meter =	0		
Concentration, C, ppm =	801		
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

PETROLEUM PROCESS HEATER

Location No. 12 Unit No. 2

Unit Description PETROLEUM PROCESS HEATER
VERTICAL FORCED DRAFT DEHEXANIZER REBOILER
WITHOUT COMBUSTION AIR PREHEAT
7362 m^3/day (46,313 bbl/day)

Installation Date 1973

Heater Rating 13.6 MW (46.5 x 10^6 Btu/hr)

Burner Description COEN BURNER DAZ 22-26
1 EACH OIL OR GAS

Test Fuel Combinations REFINERY GAS
REFINERY GAS & No. 6 OIL (1.14% SULFUR)

Fuel Temp. at Burner (°F) No. 6 OIL 367K (200°F)

Primary Air Temp. (°F) AMBIENT.

Comments:

MOBILE LABORATORY DATA Test No._____

Test No. 12/2-1 Date 10/15/76 Location 12 Engr. BWH

Unit No._____ Fuel_____ Capacity_____

Unit Type DEHEXANIZER Burner Type COEN

1. Test No.	12/2-1		12/2-2									
2. Date	10/15/76		10/15/76									
3. Time	1:05 PM		3:05 PM									
4. Load												
5. Process Rate												
6. ~~Flue Diam. or Size, ft~~ FUEL	REF. GAS		#6 OIL									
7. Probe Position	STACK		STACK									
8. Oxygen (%)	4.3		4.3									
9. NOx (hot) read/3% O_2 (ppm)	150	162	123	133								
10. NO (hot) read/3% O_2 (ppm)	130	140	120	129								
11. NO_2 (hot) read/3% O_2 (ppm)	20	22	3	4								
12. NO (cold) read/3% O_2 (ppm)	169	182	155	167								
13. Carbon Dioxide (%)	9.2		11.3									
14. Carbon Monoxide (ppm) uncor/cor	0	0	20	22								
15. Hydrocarbon (ppm) uncor/cor												
16. Sulfur Dioxide (ppm) uncor/cor	90	97	280	302								
17. Smoke Spot (Bacharach)												
18. Atmos. Temp. (°F) °C)	47											
19. Dew Point Temp. (°F) °C)	41											
20. Atmos. Pressure (in. Hg)	29.39											
21. Relative Humidity (%)	60											
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 12/2-3 Date 10/18/76 Location 12 Engr. BWH

Unit No. _____ Fuel REF. GAS Capacity _____

Unit Type DEHEXANIZER Burner Type COEN → SASS

1. Test No.	12/2-3		12/2-3		12/2-3		12/2-3		12/2-3	
2. Date	10/18/76		10/18/76		10/18/76		10/18/76		10/18/76	
3. Time	9:40 AM		9:55 AM		12:30 PM		2:40 PM		3:50	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	STACK		STACK		STACK		STACK		STACK	
8. Oxygen (%)	4.0		3.7		3.9		4.0		3.8	
9. NOx (hot) read/3% O_2 (ppm)	—	-	60	62	66	69	60	64	60	63
10. NO (hot) read/3% O_2 (ppm)	68	72	63	66	65	68	60	64	60	63
11. NO_2 (hot) read/3% O_2 (ppm)	—	-	0	0	1	1	0	0	0	0
12. NO (cold) read/3% O_2 (ppm)	—	-	83	86	90	95	78	83	78	82
13. Carbon Dioxide (%)	10.6		8.9		9.8		9.9		9.2	
14. Carbon Monoxide (ppm) uncor/cor	24	25	14	15	18	19	4	4	8	8
15. Hydrocarbon (ppm) uncor/cor										
16. Sulfur Dioxide (ppm) uncor/cor	40	42	60	62	70	74	40	42	20	21
17. Smoke Spot (Bacharach)										
18. ~~Atmos. Temp.~~ DRY BULB (°F) °C)			36				38			
19. Dew Point Temp. (°F) °C)			32				38			
20. Atmos. Pressure (in. Hg)			29.74				29.69		29.68	
21. Relative Humidity (%)			65				100			
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 12/2-3 Date 10/18/76 Location 12 Engr. BWH

Unit No. _____ Fuel REF. GAS Capacity _____

Unit Type DEHEXANIZER Burner Type COEN

1. Test No.	12/2-3									
2. Date	10/18/76									
3. Time	5:40 PM									
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	STACK									
8. Oxygen (%)	3.7									
9. NOx (hot) read/3% O_2 (ppm)	56	58								
10. NO (hot) read/3% O_2 (ppm)	56	58								
11. NO_2 (hot) read/3% O_2 (ppm)	0	0								
12. NO (cold) read/3% O_2 (ppm)	75	78								
13. Carbon Dioxide (%)	8.9									
14. Carbon Monoxide (ppm) uncor/cor	8	8								
15. Hydrocarbon (ppm) uncor/cor										
16. Sulfur Dioxide (ppm) uncor/cor	40	42								
17. Smoke Spot (Bacharach)										
18. ~~Atmos. Temp.~~ DRY BULB (°F) °C)	40									
19. Dew Point Temp. (°F) °C)	38									
20. Atmos. Pressure (in. Hg)	29.68									
21. Relative Humidity (%)	83									
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 12/2-4+5 Date 10/19/76 Location 12 Engr. BWH/BUENING

Unit No._____ Fuel REF. GAS + OIL Capacity_____

Unit Type DEHEXANIZER Burner Type COEN

	GAS		GAS		OIL					
1. Test No.	12/2-4		12/2-4		12/2-5					
2. Date	10-19-76		10-19-76		10-19-76					
3. Time	10:00		11:00		16:00					
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft	—		—							
7. Probe Position	STACK		STACK		STACK					
8. Oxygen (%)	3.1		3.7		5.0					
9. NOx (hot) read/3% O_2 (ppm)	95	96	98	102	105	118				
10. NO (hot) read/3% O_2 (ppm)	93	94	95	99	98	110				
11. NO_2 (hot) read/3% O_2 (ppm)	2	2	3	3	7	8				
12. NO (cold) read/3% O_2 (ppm)	121	122	125	130	130	146				
13. Carbon Dioxide (%)	9.2		9.2		8.9					
14. Carbon Monoxide (ppm) uncor/cor	16	17	8	8	40	45				
15. Hydrocarbon (ppm) uncor/cor	—	—	—	—	—	—				
16. Sulfur Dioxide (ppm) uncor/cor	90	91	90	94	100	113				
17. Smoke Spot (Bacharach)	—		—		4					
18. Atmos. Temp. DRY BULB (°F) °C)	37		38		42					
19. Dew Point Temp. (°F) °C)	36		36		40					
20. Atmos. Pressure (in. Hg)	29.68		29.84		29.54					
21. Relative Humidity (%)	90		83		86					
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

SOx 649 SOx PARTIC.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 12/2-6 Date 10-20-76 Location 12 Engr. BUENING

Unit No. _____ Fuel REF. GAS Capacity _____

Unit Type DEHEXANIZER Burner Type COEN

1. Test No.	12/2-6		12/2-6		12/2-6							
2. Date	10-20-76		10-20-76		10-20-76							
3. Time	11:45		14:00		16:00							
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft	64" ID		64" ID		64" ID							
7. Probe Position	STACK		STACK		STACK							
8. Oxygen (%)	3.3		3.9		4.0							
9. NOx (hot) read/3% O_2 (ppm)	113	115	103	108	110	116						
10. NO (hot) read/3% O_2 (ppm)	103	105	103	108	108	114						
11. NO_2 (hot) read/3% O_2 (ppm)	10	10	0	0	2	2						
12. NO (cold) read/3% O_2 (ppm)	125	127	128	135	130	138						
13. Carbon Dioxide (%)	10.3		9.5		9.4							
14. Carbon Monoxide (ppm) uncor/cor	0	0	8	8	4	4						
15. Hydrocarbon (ppm) uncor/cor	—	—	—	—	—	—						
16. Sulfur Dioxide (ppm) uncor/cor	70	71	40	42	60	64						
17. Smoke Spot (Bacharach)	—		—		—							
18. Atmos. Temp. (°F)/°C)	43		47		49							
19. Dew Point Temp. (°F)/°C)	42		42		45							
20. Atmos. Pressure (in. Hg)	29.49		29.46		29.42							
21. Relative Humidity (%)	92		66		74							
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

SASS 650 SASS SASS

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 12/2-7 Date 10-26-76 Location 12 Engr. BUENING

Unit No. _____ Fuel GAS Capacity _____

Unit Type DEHEXANIZER Burner Type COEN

1. Test No.	12/2-7		12/2-7		12/2-7		12/2-7					
2. Date	10-26-76		10-26-76		10-26-76		10-26-76					
3. Time	9:05		9:35		10:02		11:02					
4. Load	—		—		—		—					
5. Process Rate	—		—		—		—					
6. Flue Diam. or Size, ft												
7. Probe Position	STACK		STACK		STACK		STACK					
8. Oxygen (%)	4.8		3.2		2.2		4.9					
9. NOx (hot) read/3% O_2 (ppm)	90	100	79	80	54	52	95	106				
10. NO (hot) read/3% O_2 (ppm)	90	100	78	79	53	51	93	104				
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	1	1	1	1	2	2				
12. NO (cold) read/3% O_2 (ppm)	113	126	96	97	73	70	113	126				
13. Carbon Dioxide (%)	5.1		6.6		7.4		4.8					
14. Carbon Monoxide (ppm) uncor/cor	0	0	0	0	0	0	0	0				
15. Hydrocarbon (ppm) uncor/cor	—	—	—	—	50	48	15	17				
16. Sulfur Dioxide (ppm) uncor/cor	160	178	100	101	120	115	210	235				
17. Smoke Spot (Bacharach)	—		—		—		—					
18. Atmos. Temp. (°F/°C)	31		31		34		35					
19. Dew Point Temp. (°F/°C)	29		29		32		32					
20. Atmos. Pressure (in. Hg)	30.22		30.23		30.24		30.26					
21. Relative Humidity (%)	80		80		80		72					
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

O_2 SWING ENGINE 651

O_2 SWING LOW O_2

O_2 SWING LOW O_2

O_2 SWING HIGH O_2

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 12/2-8 Date 10-26-76 Location 12 Engr. BUENING

Unit No. _____ Fuel #6 OIL Capacity _____

Unit Type DEHEXANIZER Burner Type COEN

1. Test No.	12/2-8		12/2-8		12/2-8							
2. Date	10-26-76		10-26-76		10-26-76							
3. Time	12:20		12:40		13:50							
4. Load	—		—		—							
5. Process Rate	—		—		—							
6. Flue Diam. or Size, ft												
7. Probe Position	STACK		STACK		STACK							
8. Oxygen (%)	5.0		4.3		3.6-4.0							
9. NOx (hot) read/3% O_2 (ppm)	123	138	124	134	124	130						
10. NO (hot) read/3% O_2 (ppm)	116	131	120	129	123	129						
11. NO_2 (hot) read/3% O_2 (ppm)	7	7	4	5	1	1						
12. NO (cold) read/3% O_2 (ppm)	139	156	141	152	138	144						
13. Carbon Dioxide (%)	7.7		8.3		11.6							
14. Carbon Monoxide (ppm) uncor/cor	20	23	20	22	30	31						
15. Hydrocarbon (ppm) uncor/cor	10	11	5	5	0	0						
16. Sulfur Dioxide (ppm) uncor/cor	460	518	430	463	470	492						
17. Smoke Spot (Bacharach)	—		—		—							
18. Atmos. Temp. (°F/°C)	43		43		41							
19. Dew Point Temp. (°F/°C)	40		40		35							
20. Atmos. Pressure (in. Hg)	30.3		30.3		30.3							
21. Relative Humidity (%)	79		79		55							
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

O_2 SWING BASELINE 652

O_2 SWING

O_2 SWING REGISTER 30% OPEN

Data Sheet 6002-2

CONTROL ROOM DATA
Location 12
Unit 2

DEHEXANIZER

Data Taken By_____

Test No.	12/2-1	12/2-2			
Date	10-15-76	10-15-76			
Time	1255	1459			
Reboiler Feed Rate x 1700 B/D					
Pass A	5	5			
Pass B	5	5			
Pass C	5	5			
Pass D	5	5			
Fuel Gas to Reboiler x 108 MSCFD	.78	.30			
Oxygen Analyzer (% O_2)	5.2	5.7			
Temperatures (°F)					
Combined Outlet	387	387			
No. 1 Outlet	391	389			
No. 2 Outlet	389	388			
No. 3 Outlet	395	393			
No. 4 Outlet	392	391			
Stack	554	541			
Convection Section (top)	518	513			
Convection Section (bottom)	1251	1099			
Radiant Section	800	957			
Fuel Oil (gauge)	—	212			
Pressure Gauges					
Windbox Pressure, in. H_2O	.50	.38			
Steam/Fuel Oil Differential Pressure, psig		20			
Fuel Gas Supply, psig	36	56			
Fuel Gas Inlet, psig	31	52			
Fuel Oil Pressure, psig	0	50			
Fuel Oil to Burner, psig	—	42			

CONTROL ROOM DATA
Location 12
Unit 2

DEHEXANIZER

Data Taken By BWH

Test No.	12/2-3	12/2-3	12/2-3	12/2-3	
Date	10/18/76	10/18/76	10/18/76	10/18/76	
Time	10:05	12:49	3:55	5:00	
Reboiler Feed Rate x 1700 B/D					
Pass A	5	5	5	5	
Pass B	5	5	5	5	
Pass C	5	5	5	5	
Pass D	5	5	5	5	
Fuel Gas to Reboiler x 108 MSCFD	6.2	6.3	6.3	6.3	
Oxygen Analyzer (% O_2)	5.0	4.9	5.0	4.9	
Temperatures (°F)					
Combined Outlet	386	387	388	386	
No. 1 Outlet	388	389	389	389	
No. 2 Outlet	387	388	388	388	
No. 3 Outlet	392	393	394	393	
No. 4 Outlet	389	390	390	390	
Stack	549	545	547	546	
Convection Section (top)	514	513	514	513	
Convection Section (bottom)	1245	1237	1235	1244	
Radiant Section	813	812	819	818	
Fuel Oil (gauge)	210-OFF	—	—	—	
Pressure Gauges					
Windbox Pressure, in. H_2O	0.15	0.07	0.35	0.35	
Steam/Fuel Oil Differential Pressure, psig	22.5	22.5	23.0	22.5	
Fuel Gas Supply, psig	58	58	60	58.5	
Fuel Gas Inlet, psig	54	55	55	54	
Fuel Oil Pressure, psig	—	—	—	—	
Fuel Oil to Burner, psig	—	—	—	—	

CONTROL ROOM DATA
Location 12
Unit 2

DEHEXANIZER

Data Taken By BWH

Test No.	12/2-4	12/2-4	12/2-5		
Date	10/19/76	10/19/76	10/19/76		
Time	0939	1045	1600		
Reboiler Feed Rate x 1700 B/D					
Pass A	5	5	5		
Pass B	5	5	5		
Pass C	5	5	5		
Pass D	5	5	5		
Fuel Gas to Reboiler x 108 MSCFD	6.4	6.4	3.2		
Oxygen Analyzer (% O_2)	4.2	4.3	6.3		
Temperatures (°F)					
Combined Outlet	388	387	388		
No. 1 Outlet	390	390	389		
No. 2 Outlet	389	389	389		
No. 3 Outlet	394	394	394		
No. 4 Outlet	390	391	391		
Stack	542	540	562		
Convection Section (top)	509	507	529		
Convection Section (bottom)	1266	1260	1178		
Radiant Section	814	810	934		
Fuel Oil (gauge)	—	—	197		
Pressure Gauges					
Windbox Pressure, in. H_2O	0.26	—	1.05		
Steam/Fuel Oil Differential Pressure, psig	22.5	22.5	28.0		
Fuel Gas Supply, psig	56.5	57.5	56.5		
Fuel Gas Inlet, psig	53.0	54.0	52.0		
Fuel Oil Pressure, psig	—	—	90		
Fuel Oil to Burner, psig	—	—	18		

CONTROL ROOM DATA
Location 12
Unit 2

DEHEXANIZER

Data Taken By BWH

Test No.	12/2-6	12/2-6	12/2-6		
Date	10/20/76	10/20/76	10/20/76		
Time	1135 AM	1:45 PM	1557		
Reboiler Feed Rate x 1700 B/D					
Pass A	5	5	5		
Pass B	5	5	5		
Pass C	5	5	5		
Pass D	5	5	5		
Fuel Gas to Reboiler x 108 MSCFD	635	625	625		
Oxygen Analyzer (% O_2)	4.4	4.3	4.4		
Temperatures (°F)					
Combined Outlet	389	387	386		
No. 1 Outlet	390	389	388		
No. 2 Outlet	389	388	387		
No. 3 Outlet	394	393	392		
No. 4 Outlet	391	389	389		
Stack	542	537	532		
Convection Section (top)	508	504	501		
Convection Section (bottom)	1264	1247	1248		
Radiant Section	811	801	802		
Fuel Oil (gauge)	—	—	—		
Pressure Gauges					
Windbox Pressure, in. H_2O	0.30	0.29	0.29		
Steam/Fuel Oil Differential Pressure, psig	28.0	28.0	28.0		
Fuel Gas Supply, psig	60.0	57.0	57.0		
Fuel Gas Inlet, psig	56.0	53.0	54.0		
Fuel Oil Pressure, psig	—	—	—		
Fuel Oil to Burner, psig	—	—	—		

CONTROL ROOM DATA
Location 12
Unit 2

DEHEXANIZER

Data Taken By BWH

Test No.	12/2-7	12/2-7	12/2-7	12/2-7	
Date	10/26/76	10/26/76	10/26/76	10/26/76	
Time	0908	0937	1010	1100	
Reboiler Feed Rate x 1700 B/D					
Pass A	5	5	5	5	
Pass B	5	5	5	5	
Pass C	5	5	5	5	
Pass D	5	5	5	5	
Fuel Gas to Reboiler x 108 MSCFD	7.2 0	7 30	7.1.0	7.2.0	
Oxygen Analyzer (% O_2)	5.8	4.5	4.0	5.8	
Temperatures (°F)					
Combined Outlet	390	388	387	390	
No. 1 Outlet	391	390	390	391	
No. 2 Outlet	390	389	389	390	
No. 3 Outlet	395	394	394	395	
No. 4 Outlet	391	391	391	392	
Stack	585	574	562	586	
Convection Section (top)	546	537	524	549	
Convection Section (bottom)	1260	1278	1283	1266	
Radiant Section	832	843	838	832	
Fuel Oil (gauge)	—	—	—	—	
Pressure Gauges					
Windbox Pressure, in. H_2O	0.80	0.37	0.19	0.90	
Steam/Fuel Oil Differential Pressure, psig	—	—	—	—	
Fuel Gas Supply, psig	57.0	56.5	56.0	57.0	
Fuel Gas Inlet, psig	53.0	53.0	52.0	53.0	
Fuel Oil Pressure, psig	—	—	—	—	
Fuel Oil to Burner, psig	—	—	—	—	

CONTROL ROOM DATA
Location 12
Unit 2

DEHEXANIZER

Data Taken By BWH

Test No.	12/2-8	12/2-8	12/2-8	12/2-8	
Date	10/26/76	10/26/76	10/26/76	10/26/76	
Time	1214	1242	1323	1350	
Reboiler Feed Rate x 1700 B/D					
Pass A	5	5	5	5	
Pass B	5	5	5	5	
Pass C	5	5	5	5	
Pass D	5	5	5	5	
Fuel Gas to Reboiler x 108 MSCFD	3.1	3.0	3.0	3.0	
Oxygen Analyzer (% O_2)	5.6	5.2	4.6	4.8	
Temperatures (°F)					
Combined Outlet	388	389	388	388	
No. 1 Outlet	389	389	389	388	
No. 2 Outlet	389	389	389	389	
No. 3 Outlet	394	394	394	393	
No. 4 Outlet	391	391	391	391	
Stack	567	561	553	553	
Convection Section (top)	530	526	518	517	
Convection Section (bottom)	1197	1188	1192	1191	
Radiant Section	966	968	978	970	
Fuel Oil (gauge)	211	209	208	208	
Pressure Gauges					
Windbox Pressure, in. H_2O	0.80	0.65	0.47	0.37	
Steam/Fuel Oil Differential Pressure, psig	30.0	30.0	30.0	30.0	
Fuel Gas Supply, psig	58.5	58.5	58.5	57.5	
Fuel Gas Inlet, psig	55.0	56.0	55.5	55.5	
Fuel Oil Pressure, psig	25.5	25.5	25.5	25.5	
Fuel Oil to Burner, psig	20.0	20.0	20.0	20.0	

LOCATION 12

UNIT 2

NO. 6 FUEL OIL ANALYSIS

Test 12/2-2

November 15, 197(

Carbon, %	87.22
Hydrogen, %	10.33
Nitrogen, %	0.27
Sulfur, %	1.14
Ash, %	0.035
Oxygen, % (by difference)	1.00
API Gravity at 60°F	12.6
Heat of Combustion:	
Gross BTU/lb.	18,380
Net BTU/lb.	17,440

LOCATION 12

UNIT 2

FUEL GAS CHROMATOGRAPHIC ANALYSES

The six samples of gas were marked as follows:

1. Test 12/2-4, 1115 hrs., 10-19-76
2. Test 12/2-3, 1630 hrs., 10-18-76
3. Test 12/2-3, 1300 hrs., 10-18-76
4. Test 12/2-1, 1300 hrs., 10-15-76
5. Test 12/2-6, 1400 hrs., 10-20-76
6. Test 12/2-6a, 1400 hrs., 10-20-76

Samples #5 and #6 had the same identification, so an "A" was added to the last sample number. It arrived with a pressure of 1 atmosphere, so it may have leaked en route.

The following table summarizes the results of the gas chromatographic analyses expressed as per cent by volume:

Sample Number:	1	2	3	4	5	6
Oxygen	0.031	0.025	0.034	0.023	0.023	10.1
Nitrogen	2.29	0.95	2.40	1.00	0.86	38.1
Carbon Dioxide	0.013	0.013	0.013	0.013	0.013	0.052
Carbon Monoxide	0.09	< 0.04	0.04	0.07	< 0.04	< 0.04
Hydrogen	54.4	53.3	52.9	51.2	53.8	17.9
Methane	19.0	19.9	17.8	18.5	16.7	12.8
Ethylene	5.71	6.12	6.30	5.21	6.24	4.41
Ethane	9.69	10.3	11.0	9.87	11.1	7.70
C3 Hydrocarbons	6.05	6.39	6.61	11.4	8.35	6.62
C4 Hydrocarbons	2.07	2.23	2.16	2.11	2.18	1.69
C5 Hydrocarbons	0.41	0.48	0.46	0.42	0.45	0.34
C6 Hydrocarbons	0.22	0.28	0.24	0.22	0.29	0.22
Heating Value (BTU dry/SCF)	879	921	915	996	953	637

NOTE: The high hydrogen content required a separate gas chromatographic analysis.

MODIF. METH. 5

PARTICULATE EMISSION CALCULATIONS

Test No. 12/2-5 Date 10-19-76 Location 12 Engr. BUENING

Unit No. _____ Fuel #6 OIL Sampling Train and Method _____

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} 29.80 in. Hg

Tot. Liquid Collected, V_{lc} 185 ml Total Particulate, M_n 198.0 m gm

Velocity Head, ΔP .03 iwg Stack Temp., Ts 1070 °R Stack Area, As 22.34 ft^2

Sample Volume, Vm 60 ft^3 Stack Press., Psg -.73 iwg Excess O_2, XO_2% 5.0 %

Orifice Press. Diff., H .48 iwg Stack Gas Sp. Gravity, Gs 1.0 n.d.

Sample Time, θ 120 min Nozzle Dia., Dn 1/2 in. Meter Temp., T_m _____ °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	59.79 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	8.769 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.128 N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	.05099 grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	7.302×10^{-6} lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	11.69×10^{-2} grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	404.55 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	820.71 ft/min
7. Stack Gas Flow Rate @ 70°F	a. Qsw = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	9026.99 WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	7871.54 DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	3.449 lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	131.45 N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	8.849 lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	38.055 ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	103.68 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

METHOD 5

PARTICULATE EMISSION CALCULATIONS

Test No. 12/2-5 Date 10-19-76 Location 12 Engr. BUENING

Unit No. _____ Fuel #6 OIL Sampling Train and Method —

Pitot Factor, Ps .83 Barometric Pressure, P_{bar} 29.80 in. Hg

Tot. Liquid Collected, V_{lc} 185 ml Total Particulate, M_n 164.7 m gm

Velocity Head, ΔP .03 iwg Stack Temp., Ts 1070 °R Stack Area, As 22.34 ft^2

Sample Volume, Vm 60 ft^3 Stack Press., Psg -.73 iwg Excess O_2, XO_2% 5.0 %

Orifice Press. Diff., H .48 iwg Stack Gas Sp. Gravity, Gs 1.0 n.d.

Sample Time, θ 120 min Nozzle Dia., Dn 1/2 in. Meter Temp., T_m _____ °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	59.79 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	8.769 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.128 N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	.04242 grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	6.074×10^{-6} lb/DSCF
	c. C = Eq. 4b x 16.018 x 10^3	9.73×10^{-2} grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	404.55 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	820.71 ft/min
7. Stack Gas Flow Rate @ 70°F	a. Qsw = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	9026.99 WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	7871.54 DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	2.869 lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	131.45 N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	7.361×10^{-2} lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	31.655 ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	103.68 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by 530/T_m (°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS SASS

Test No. 12/2-3 Date 10-18-76 Location 12 Engr. _____

Unit No. 2 Fuel REF. GAS Sampling Train and Method _____

Pitot Factor, Fs 0.83 Barometric Pressure, P_{bar} 29.69 in. Hg

Tot. Liquid Collected, V_{lc} 2059 ml Total Particulate, M_n _____ mg gm

Velocity Head, ΔP .02 iwg Stack Temp., Ts 1069 °R Stack Area, As 22.34 ft^2

Sample Volume, Vm 471.253 ft^3 Stack Press., Psg -.68 iwg Excess O_2, XO_2% 3.85 %

Orifice Press. Diff., H 1.0 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 300 min Nozzle Dia., Dn 11/16 in. Meter Temp., T_m 514 °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6) \times \frac{530}{514}$	483.06 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	97.60 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.168 N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	_____ grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	_____ lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	_____ grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	403.1 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	668 ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	7328 WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	6097 DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	_____ lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	_____ N.D.
10. Emission	a. E = Eq. 4b x Fs x Eq. 9	_____ lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	_____ ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	229 %

	Oil	Gas	Coal
Fs SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$ (°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS SASS

Test No. 12/2-6 Date 10-20-76 Location 12 Engr. _____

Unit No. 2 Fuel REF. GAS Sampling Train and Method _____

Pitot Factor, Fs 0.83 Barometric Pressure, P_{bar} 29.46 in. Hg

Tot. Liquid Collected, V_{lc} 1258 ml Total Particulate, M_n _____ m gm

Velocity Head, ΔP 0.02 iwg Stack Temp., Ts 1064 °R Stack Area, As 22.34 ft^2

Sample Volume, Vm 392.018 ft^3 Stack Press., Psg -.68 iwg Excess O_2, XO_2% 3.7 %

Orifice Press. Diff., H 1.0 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 300 min Nozzle Dia., Dn 11/16 in. Meter Temp., T_m 516 °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6) \times \frac{530}{516}$	397.19 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	59.63 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.130 N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	_____ grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	_____ lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	_____ grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	399.98 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	675 ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	7382 WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	6422 DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	_____ lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	1.215 N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	_____ lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	_____ ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	179 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE CALCULATION SHEET

Test No. 12/2-5 Date OCT. 19 1976 Location 12 Test Crew _____

Box No. _____ Sample Probe Position _____

Test Description PARTIC. ON OIL FUEL

Dry Gas Meter Vol. (ft^3)

Final 1600.35

Initial 1540.35

Total 60

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final	250	116	2	687.6	1055.6
Initial	100	100	0	670.6	870.6
Δ Vol	150	16	2	17.0	185.0

Beaker No.	3	10	5	H_2O BLANK 8	ACE. BLANK 9	Filter No. 9	Blank No. 10
Date Weighed	10/19/76	10/19/76	10/19/76	10/19/76	10/19/76	10/19/76	10/19/76
Tare Wt. 1	101.9888	100.9593	98.9403	99.3383	100.1893	0.8013	0.8078
2	101.9888	100.9390	98.9402	99.3383	100.1891	0.8013	0.8079
3	101.9886	100.9387	98.9397	99.3384	100.1886	0.8013	0.8079
4	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—
6	—	—	—	—	—	—	—
Avg	101.9887	100.9390	98.9401	99.3383	100.1890	.8013	.8079
Bottle No.	1 + 4	2	3				
Content	Impinger (Water)	Probe (Acetone)	Probe (Water)	~~Cyclone (Acetone)~~	~~Flask (Dry)~~		
Rinse (ml)	650	450	200	200	200		
Date Weighed or 250 Bake	10-21-76	10-21-76	10-21-76	10-21-76	10-21-76	10-21-76	10-21-76
Final Wt. 250 1	102.0074	100.9815	98.9543	~~99.3402~~	100.1894	0.9240	.8083
2	102.0079	100.9813	98.9544	99.3359	100.1889	.9238	.8081
3	102.0080	100.9800	98.9543	99.3354	100.1887	.9238	.8080
4				99.3348			
5							
6							
Avg	102.0078	100.9813	98.9543	99.3354	100.1890	.9239	.8081
Residue wt Final 250-Tare	.0191	.0423	.0142	∅	∅	.1226	+.0002
Date Weighed or 650 Bake							
Final Wt. 650 1							
2							
3							
4							
5							
6							
Avg							
Residue Wt Final 650-Tare							

Comments:

Data Sheet 6002-3

PLANT
LOCATION 12
OPERATOR
DATE 10/19/76
RUN NO. 12/2-5
SAMPLE BOX NO.
METER BOX NO.
METER H
C FACTOR @ .83

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 38 °F
BAROMETRIC PRESSURE 29.8 in. Hg.
ASSUMED MOISTURE, % 15
HEATER BOX SETTING 7
PROBE LENGTH, IN. 48
NOZZLE DIAMETER, IN. 1/2
PROBE HEATER SETTING 3

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time ~~(c) Min.~~ CLOCK TIME	Static Pressure (P_g), In. Hg.	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume METER READING (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter: Inlet ($T_{min.}$) °F	Gas Sample Temperature at Dry Gas Meter: Outlet (T_{mout}) °F	Sample Box Temprature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
	1539	-.73	620	.03	.48	1540.35		60	280	45
	1554		605	.03	.48	1548.25		70	320	42
	1609		600	.03	.48	1555.85		72	315	43
	1624									
	1639									
	1654		605	.03	.48	1578.35		85	320	40
	1739	↓	618	.03	.48	1600.35		80	350	42
TOTAL								AVG.	AVG.	
AVERAGE								AVG.		

999

PLUME OPACITY OBSERVATION RECORD

Test Run No. _____

LOCATION NO. 12 OBSERVER HANS

OWNER _____ BOILER NO. _____ CAPACITY _____ klb/hr

DATE OCT. 19, 1976 FUEL TYPE #6 OIL BURNER TYPE COEN

POINT OF EMISSION STACK

POINT OF OBSERVATION 150 YARDS WEST OF STACK

TEST No.	TEST Time am/pm	TEST Type	Test Load kø/hr	Opacity %	WIND Speed mph	WIND Direct.	Sky Cond.	Sun Position	Comments
	16:00	PARTIC.		10	5	SOUTH	CLOUDY	—	
	16:05	↓		10	↓	↓	↓	—	
	16:10			10				—	
	16:15			10				—	
	16:20			10				—	
	16:25			10				—	
	16:30			10				—	
	16:35			10				—	
	16:40	↓		10	↓	↓	↓	—	

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 10-15-76 _____

Location: 12 _____

Unit: 2 _____

Test: _____ Personnel: _____

Fuel: _____ _____

Barometric Press. (in. Hg): _____

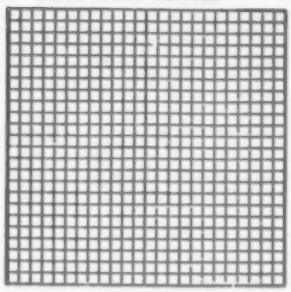
Absolute Static Press. in Stack (in. Hg): _____ (P_g)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

$\Delta P_s = 0.73$ iwg

Stack Cross Section



Time	Traverse Port	Point Depth (in.)	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_S	Molecular Wt. M_S	Velocity (ft/sec) V_S	O_2 Conc. (% Dry)
		3	.01 .07	556			24.4	4
		10	.01 .07	↓			24.4	
		19	.05 .08				26.1	
		45	.09 .10				29.2	
		54	.09 .10				29.2	
		61	.11	↓			30.6	

6002-13

VELOCITY TRAVERSE

Project:_____ Test Description:___

Date:_____ _____

Location: 12 _____

Unit: 1 _____

Test:_____ Personnel:_____

Fuel:_____ _____

Barometric Press. (in. Hg):_____

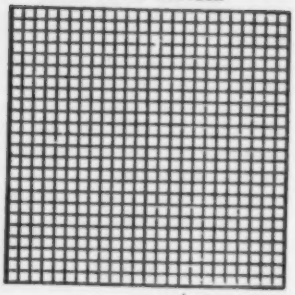
Absolute Static Press. in Stack (in. Hg):_____ (P_g)

Pitot Tube Coefficient:_____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

$\Delta P_s = 2.5$ iwg

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
	#3	9	.06	1472			31.2	2.2
		27	.07				33.7	
		45	.06				31.2	
		63	.01				12.7	
		9	.01				12.7	
		27	.06				31.2	
		45	.03				22.1	
		63	.06				31.2	
		9	.01				12.7	
		27	.03				22.1	
		45	0				0	
		63	0				0	

6002-13

Date 19 OCT. 76 KVB, INC. Test No. 12/2-4

SOx DATA SHEET

TEST NO. 12/2-4 UNIT NO. _____ FUEL Nat Gas LOAD _____ klb/hr ____ Location 12

Box No.	1	1			
Time	0931	0950			
Temp. in Gas Meter	48	50			
Press. in Gas Meter	0	0			
Meter Reading	0	1.000			
Barom. Press.	29.82	29.82			
Percent Oxygen	3.1	3.1			
N_2 Purge Time	0953	1023			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V\ (P + p)}$

Excess O_2 3.1 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	9.8	13.5	
B = Ml of lead perchlorate used for bland =	8.1	8.1	
N = Normality of lead perchlorate titrant =	.0179	.0179	
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	509	509	
V = Volume of gas sample ft^3 =	1.000	1.000	
P = Barometric pressure =	29.82	29.82	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	125	40	
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ $dscm/10^4$ cal

_____ $dscf/10^4$ Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 19 OCT. '76

K V B. INC.

Test No. 12/2-4

SOx DATA SHEET

TEST NO. 12/2-4 UNIT NO. ____ FUEL R.F.GAS LOAD ____ klb/hr ____ Location 12

Box No.	2	2			
Time	1004	1025			
Temp. in Gas Meter	50	52			
Press. in Gas Meter	0	0			
Meter Reading	0	1.000			
Barom. Press.	29.82	29.82			
Percent Oxygen					
N_2 Purge Time	1026	1056			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V (P + p)}$

Excess O_2 _____%

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	10.3	11.6	
B = Ml of lead perchlorate used for bland =	8.1	8.1	
N = Normality of lead perchlorate titrant =	.0179	.0179	
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	511	511	
V = Volume of gas sample ft^3 =	1.000	1.000	
P = Barometric pressure =	29.82	29.82	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	162	25	
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 19 OCT '76

KVB, INC.

Test No. 12/2-4

SOx DATA SHEET

TEST NO. 12/2-4 UNIT NO. ____ FUEL R.F. 6#5 LOAD ____ klb/hr ____ Location 12

Box No.	1	1			
Time	1036	1058			
Temp. in Gas Meter	49	51			
Press. in Gas Meter	0	0			
Meter Reading	0	1.000			
Barom. Press.	29.82	29.82			
Percent Oxygen	3.7	3.7			
N_2 Purge Time	1100	1130			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V\,(P + p)}$

Excess O_2 3.7 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	10.0	11.0	
B = Ml of lead perchlorate used for bland =	8.1	8.1	
N = Normality of lead perchlorate titrant =	.0179	.0179	
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	510	510	
V = Volume of gas sample ft^3 =	1.000	1.000	
P = Barometric pressure =	29.82	29.82	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	140	21	
, gm/dscm =			
Emission - , E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

TABLE TRACE SPECIES AND ORGANICS SAMPLING CONDITIONS
PETROLEUM PROCESS HEATER - LOCATION 12/2

TS&O Run No.	1	2
Test No.	12/2-3	12/2-6
Date	10/17/76	10/20/76
Port Location	℄	℄
Velocity, m/s (f/s)	3.39 (11.1)	3.42 (11.3)
Stack Temp., K (°F)	594 (609)	591 (604)
Oxygen Content, % dry	3.85	3.7
Moisture, %	16.8	13.0
Sample time, min.	300	300
Cyclone Flow, awcmm (awcfm)	0.0895 (3.16)	0.070 (2.46)
Isokinetic Rate, %	229	179
Oven Temp., K (°F)	477 (398)	480 (403)
XAD-2 Temp., K (°F)	293 (67)	293 (68)
Meter Temp., K (°F)	286 (56)	287 (57)
Nozzle Size, mm (in.)	12 (0.688)	12 (0.688)
No. Filters Used	1	1
Sample Flow, Dry, scmm (scfm)	0.046 (1.61)	0.037 (1.32)
Volume Collected, Dry, scm (scf)	13.67 (483)	11.24 (397)
Particulate weight, g	0	0
Solid Particulates, ng/J (lb/10^6 Btu)	0	0
Stack Flow Rate, Nm^3/s (scfm)	2.9 (6145)	3.03 (6420)

KVB, Inc. Trace Species and Organics Sampling Data

Project: EPA PHASE III SASS Personnel: MANESSA HAGERTY, HEAWING Barometric Press: _____

Date: 10/18/76 _____

Location: 12 _____ FILTER 277

Unit: _____ Probe Nozzle Diameter (inches): 11/16 (Dn)

Test: 12/2-3 Absolute Static Press. in Stack (in. Hg): _____ (Ps)

Fuel: REF. GAS Pitot Tube Coefficient: _____ (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In/Out		
1300	0		.07	MED ORI 5.5	648.147	16	625	541	70	43	391	55	49	
1330	30		.02	MED ORI 1.0	740.900	4.2	608	479	69	64	398	74	60	
1400	60		.02	MED ORI 1.0	785.600	4.2	601	419	66	50	396	55	53	
1405	65	STOPPED	.02	MED ORI 1.0	792.000									
1408	65	START	.02	LARGE 1.2	792.000	16.0								
1429	86	STOPPED	.02	LG. ORI 1.0	854.300									
1431	86	START	.02	MED ORI 1.0	854.300	4.2	607	413	74	51	399	69	60	
1435	90		.02	MED ORI 1.0	861.300	4.2	601	402	70	47	396	62	62	
1505	120	STOPPED	.02	1.0	901,800	4.2	604	402	66	49	397	53	53	
1507	120	START	.02	1.0	901.800	4.2	CHANGED DESSICANT							
1537	150		.02	1.0	944.300	4.8	610	426	65	47	399	57	52	
1607	180		.02	1.0	987.400	4.9	612	426	65	51	403	59	53	
1637	210		.02	1.0	031.400	4.9	613	427	65	54	402	59	53	
1707	240		.02	1.0	075.300	4.9	612	427	66	57	402	58	53	
1737	270		.02	1.0	119.400	5.0	608	418	66	55	401	51	50	
1807	300		.02	1.0		5.0	606	420	65	54	398	52	48	

KVB 6002-12

KVB, Inc. Trace Species and Organics Sampling Data

Project: SASS TRAIN Personnel: PIONESSA, HAGERTY BUENING, HENNING Barometric Press: 29.52

Date: 10/20/76

Location: 12

Unit: Probe Nozzle Diameter (inches): (Dn)

Test: 12/2-6 Absolute Static Press. in Stack (in. Hg): -.68 (Ps)

Fuel: REF. GAS Pitot Tube Coefficient: (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In	Meter Out	
1115	0		.02	1.0	168.982	4.5	609	407	60	51	405	48	48	
1145	30		.02	1.0	213.500	4.5	606	435	65	58	403	53	49	
1215	60		.02	1.0	255.300	4.5	602	434	65	56	398	54	51	
1245	90		.02	1.0	300.000	4.9	606	431	70	59	406	55	53	
1315	120		.02	1.0	342.800	4.9	601	430	69	54	400	62	56	
1345	150		.02	1.0	385.100	4.9	607	414	70	56	404	63	63	
			CHANGED DESSICANT											
1348:30	150		.02	1.0	385.100	4.7	603	403	71	59	406	63	62	
1419	180		.02	1.0	429.800	4.9	605	437	72	58	406	58	58	
1448	210		.02	1.0	473.600	4.9	607	438	65	60	408	58	57	
1519	240		.02	1.0	517.000	4.9	602	435	75	60	400	57	55	
1549	270		.02	1.0	561.000	4.9	601	431	65	64	403	60	58	
1619	300		.02	1.0		4.9	603	434	72	63	401	58	58	

EPA 6002-12

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 12/2-3 Date 10-18-76 Location 12 Petroleum Process Heater

Sample Port Position Stack - No Collector - Gas Fuel

No SSMS

Container Number	Sample Description	Container Type	Net wt/vol.	Comment
	No Solids			
277	S #1 Filter	Petri	?~0.1g	137.8611 Tare Broken.
472	L P+N+10μ Wash	16oz AWM.	324ml	691ml (A *)
369	L 3μ Wash	8oz A	156ml	
371	L 1μ Wash	"	111 ml	
372	L Filt. Hous. Wash.	"	100ml	
374	L XAD-2 Mod. Rinse	"	204ml	617 ml. (B *)
376	L "	"	217ml	
377	L "	"	196ml	
298	S XAD-2 Resin	16oz AWM	158g	437-279
464	L XAD-2 Condensate	16oz A	254ml	1954ml. (C * & POM PCB)
468	L "	"	428ml	
469	L "	"	416ml	
473	L "	"	432ml	
474	L "	"	424ml	
501	L Impinger #1	1 l N	346ml	1338-350-50ml (C)
524	L "	"	992ml	(Basically Bottom) No PCB POM
308	L Impinger #2	"	1012ml	1620-1250=370ml
502	L "	"	608ml	
526	L Impinger #3	"	414ml	416-125=291ml
378	LB IPA Blank	8oz A	186ml	No POM PCB
373	LB H_2O Blank	"	212 ml	
375	LB 50/50 Blank	"	162ml	
361	LB Imp 2&3 Blank	"	128ml	
	Fuel Is Gas - No Analysis Possible			
Count	S - 2 Solids	9 Analyses		
	L - 3 Train Liquids	23 Bottles		
	LB 4 Blanks			

C - Make A Separate Sample For Sulfates & Nitrates Only

Data Sheet KVB 6002-15

-Do Not Do Sulf. & Nit. On 308, 502, 526.

12-Petroleum Process Heater

Test 12/2-3 TABLE Stack - no collector - gas fuel

POLLUTANT	SAMPLE NUMBER							
	277+	A*	B*	298+	C*	C_1*	378*	373*
Antimony	—	<0.5	<0.5	<50	<0.5	no metals to be run on sub-1's	<0.5	<0.5
Arsenic	—	<0.010	<0.010	<3	<0.010		<0.010	<0.010
Barium	—	<0.05	<0.05	<2.5	<0.05		<0.05	<0.05
Beryllium	—	<0.005	<0.005	<0.5	<0.005		<0.005	<0.005
Cadmium	—	<0.01	<0.01	6400	<0.01		<0.01	<0.01
Calcium	—	0.05	0.30	<0.5	0.20		<0.05	0.25
Chromium	—	0.17	0.15	7.0	0.05		<0.05	<0.05
Cobalt	—	0.08	<0.05	<25	<0.05		<0.05	<0.05
Copper	—	0.08	0.03	2.0	0.01		<0.01	<0.01
Iron	—	16.0	2.3	80.0	0.86		<0.05	0.64
Lead	—	<0.03	<0.03	<5	<0.03		<0.03	<0.03
Manganese	—	3.2	0.31	8.0	0.050		<0.01	0.041
Mercury	~<0.2[1]	<0.005	<0.005	<0.5	<0.005		<0.005	<0.005
Nickel	—	1.5	0.15	<2.5	<0.1		<0.1	<0.1
Selenium	—	<0.01	<0.01	<5	<0.01		<0.01	<0.01
Tellurium	—	<5	<5	<25	<5		<5	<5
Tin	—	<1	<1	<250	<1		<1	<1
Titanium	—	<1	<1	90	<1		<1	<1
Vanadium	—	<0.1	<0.1	<5	<0.1		<0.1	<0.1
Zinc	—	0.15	0.072	11.0	0.056		<0.005	0.058
Chloride	520	6.0	6.0	2.6	29.8	—	1.00	1.98
Fluoride		0.40	0.32	36.1	0.55	—	<0.20	<0.20
Nitrates	<200	0.22	0.12	2.0	<0.10	<0.10	0.12	0.30
Sulfates	780,000	24.0	18.0	220	11500	2300	<5	<5
+ ug/g		472, 364,	374, 376,		[illegible], [illegible],	[illegible], [illegible],		
* ug/ml		371, 372	377,		464, 473, 474, 501, 524, 308, 502, 526	464, 473, 474, 501, 524		

[1] minus paper blank

Test 12/2-3 TABLE Stack - no collector-gas fuel

POLLUTANT	SAMPLE NUMBER							
	375*	351*						
Antimony	<0.5	0.8						
Arsenic	<0.010	<0.010						
Barium	<0.05	<0.05						
Beryllium	<0.005	<0.005						
Cadmium	<0.01	0.01						
Calcium	0.20	0.70						
Chromium	<0.05	<0.05						
Cobalt	<0.05	<0.05						
Copper	<0.01	0.01						
Iron	<0.05	0.33						
Lead	<0.03	1.2						
Manganese	<0.01	0.01						
Mercury	<0.005	<0.005						
Nickel	<0.1	0.1						
Selenium	<0.01	<0.01						
Tellurium	<5	<5						
Tin	<1	<1						
Titanium	<1	<1						
Vanadium	<0.1	<0.1						
Zinc	<0.005	0.054						
Chloride	4.96	43.6						
Fluoride	<0.30	<0.50						
Nitrates	0.14	<0.10						
Sulfates	<5	22400						

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 12/2-6 Date 10-20-76 Location 12-Petroleum Process Heater

Sample Port Position Stack - No Collector - Gas Fuel

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment
		No Solids			
	278	S #1 Filter	Petri	0.1019g	Do solids, then AA 133.0991 Tot.
	353	L P+N+10μ Wash	8 oz A	186ml	
D *	354	L "	"	213ml	
	347	L 3μ Wash	"	146ml	761.
	348	L 1μ Wash	"	114ml	
	349	L Filter Hous Wash	"	102ml	
E *	343	L XAD-2 Mod Rinse	"	200ml	
	344	L "	"	196ml	682
	345	L "	"	212ml	
	350	L "	"	74ml	
Dup.	534	S XAD-2 Resin	16 oz AWM	160g	439-279
	352	L XAD-2 Condensate	8 oz A	186ml	1258ml
	527 F1	L "	1 l N	1072ml	
Dup	511	L Impinger #1	"	982ml	1362-975-387 Rinse
F *	512	L "	"	380ml	
	513	L Impinger #2	"	888ml	1248-878 = 370 Rinse
No PCM PCB	514	L "	"	360ml	
	515	L Impinger #3	"	920ml	920-257 = 283 Rinse
			[illegible]	Sample	Rinse
			F	4788	1040
			F1	2620	387
	Count	S - 2 Train Solids			
		6 Dup - 1	18 Bottles		
		L - 3 Train Liquids			
		1 Dup - 1			
		5 Analyses + 2 Dups			
	F1	Make A Separate Sample For Sulfates & Nitrates Only			

Do Not Do Sul & Nit. On 513, 514, 515

Data Sheet KVB 6002-15

* Combine

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 12/2-6 Date 10-20-76 Location 12 - Pet. Proc. Htr

Sample Port Position Stack

SSMS For 12/2-6

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment
12/2-6A	278	S Filter	Petri	0.1019	100%
					SSMS First Then AA
12/2-6B	534	S XAD-2 Resin.	16 oz AWM	160 g	100%
12/2-6C	343	L XAD-2 Mod Rinse	8 oz A	200 ml	
	344 E	"		196 ml	692 ml 12%
	345	"		212 ml	
	350	"		74 ml	
	352	XAD Condensate		186 ml	1250 23%
F1	527	"	1 L N	1072 ml	
	511 F	Imp # 1		982 ml	1362 ml 25%
	512	"		380 ml	
	513	Imp # 2		880 ml	1248 ml 23%
	514	"		360 ml	
	515	Imp # 3		920 ml	17%
				5470	
		S-2			
		L-1			
		3 Analyses			

Data Sheet KVB 6002-15

Test 12/2-6 TABLE Stack-no collector-gas fuel

POLLUTANT	SAMPLE NUMBER							
	278+	D*	E*	534+	534+ dupl	F*	F* dupl	F_1*
Antimony	—	<0.5	<0.5	<50	<50	<0.5	<0.5	
Arsenic	—	<0.010	<0.010	<3	<3	<0.010	<0.010	
Barium	—	<0.05	<0.05	10.0	5.0	<0.05	<0.05	
Beryllium	—	<0.005	<0.005	<0.5	<0.5	<0.005	<0.005	
Cadmium	—	0.01	<0.01	0.5	0.5	<0.01	<0.01	
Calcium	—	0.10	0.30	28000	24000	0.08	0.08	
Chromium	—	0.21	0.19	6.5	5.5	0.10	0.05	
Cobalt	—	<0.05	<0.05	<25	<25	<0.05	<0.05	
Copper	—	0.02	<0.01	2.0	2.0	<0.01	<0.01	
Iron	—	7.9	1.2	190	210	0.80	0.82	
Lead	—	<0.03	<0.03	12.0	11.0	<0.03	<0.03	
Manganese	—	2.1	0.17	20.0	22.0	0.037	0.041	
Mercury	<0.2	<0.005	<0.005	<0.5	<0.5	<0.005	<0.005	
Nickel	—	0.85	0.15	7.5	6.5	0.10	0.10	
Selenium	—	<0.01	<0.01	<5	<5	<0.01	<0.01	
Tellurium	—	<5	<5	<25	<25	<5	<5	
Tin	—	<1	<1	<250	<250	<1	<1	
Titanium	—	<1	<1	225	220	<1	<1	
Vanadium	—	<0.1	<0.1	<5	<5	<0.1	<0.1	
Zinc	—	0.040	0.010	16.0	19.0	0.030	0.023	
Chloride	4800	4.96	<0.6	<2.6	2.6	12.8	12.8	—
Fluoride		<0.20	<0.20			0.25	0.26	—
Nitrates	(360)	0.24	<0.10	3.6	2.6	<0.10	<0.10	0.14
Sulfates	914000	13.0	10.0	230	150	16800	17000	1000
		353, 354, 347, 348, 349	343, 344, 345, 350			352, 527, 511, 512, 513, 514, 515		352, 527, 511, 512

no metals

KVB Analysis Data

Test	Sample Number	POM's	PCB's
12/2-3	298	< 1 ug/g	< 1 ug/g
12/2 6 E		10 ug/g	< 1 ug/g
12/2-6	534	< 1 ug/g	< 1 ug/g
	534 (duplicate)	< 1 ug/g	< 1 ug/g
13-18	740	90 ug/g	< 1 ug/g
13-18	282	49 ug/g	< 1 ug/g
13-18	530	3.2 ug/g	< 1 ug/g
13-18	1038	6.3 ug/g	< 1 ug/g
13-18	1032	396 ug/g	< 1 ug/g
13-18	1033	1 ug/g	< 1 ug/g
13-18	1034	8 ug/g	< 1 ug/g
13-18	1034 (duplicate)	9 ug/g	< 1 ug/g
13-24	735	513 ug/g	< 1 ug/g
	531	6.9 ug/g	< 1 ug/g
	1039	20 ug/g	< 1 ug/g
	1035	144 ug/g	< 1 ug/g
	1036	10 ug/g	< 1 ug/g
	1037	7.1 ug/g	< 1 ug/g
	1037 (duplicate)	8.5 ug/g	< 1 ug/g
14	556	70.5 ug/g	< 1 ug/g
	568	104 ug/g	< 1 ug/g
	532	10.7 ug/g	< 1 ug/g
	532 (duplicate)	8.2 ug/g	< 1 ug/g
15-10	1041	< 0.1 ug/g	< 1 ug/g
	1041 (duplicate)	< 0.1 ug/g	< 1 ug/g
	1042	*	*
15-11	941	< 1 ug/l	< 1 ug/l
	1044	< 0.1 ug/g	< 1 ug/g
	1045	*	*
19-1	LF	*	*
19-2	533	< 0.1 ug/g	< 1 ug/g
	533 (duplicate)	< 0.1 ug/g	< 1 ug/g
	C	< 1 ug/l	< 1 ug/l
	C (duplicate)	< 1 ug/l	< 1 ug/l
	LF	*	*

*Sample extracts too concentrated to be able to determine an analytical value.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 738-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9221

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 12/2-6 A 278

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.6	Terbium	<0.1	Ruthenium		Vanadium	1
Thorium	0.8	Gadolinium	0.1	Molybdenum	0.5	Titanium	12
Bismuth	≤0.1	Europium	<0.1	Niobium	<0.1	Scandium	<0.1
Lead	6	Samarium	0.2	Zirconium	10	Calcium	MC
Thallium	0.2	Neodymium	0.1	Yttrium	0.6	Potassium	>500
Mercury	NR	Praseodymium	<0.1	Strontium	3	Chlorine	150
Gold		Cerium	0.5	Rubidium	3	Sulfur	MC
Platinum		Lanthanum	1	Bromine	0.7	Phosphorus	23
Iridium		Barium	35	Selenium	≤0.2	Silicon	MC
Osmium		Cesium	0.1	Arsenic	2	Aluminum	MC
Rhenium		Iodine	0.2	Germanium	<0.1	Magnesium	MC
Tungsten	≤0.3	Tellurium	≤0.3	Gallium	0.5	Sodium	MC
Tantalum		Antimony	0.3	Zinc	35	Fluorine	≈350
Hafnium	0.3	Tin	4	Copper	14	Oxygen	NR
Lutetium		Indium	STD	Nickel	8	Nitrogen	NR
Ytterbium		Cadmium	0.3	Cobalt	0.8	Carbon	NR
Thulium		Silver	42	Iron	190	Boron	150
Erbium		Palladium		Manganese	8	Beryllium	<0.01
Holmium		Rhodium		Chromium	12	Lithium	0.1
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.1 ppm weight

Approved: M Stevens

Total wt. of filter was 0.7011 as received. A 0.1457 g. portion was acid leached in ultra-

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 230 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14035 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John Michalovic
Calspan Corporation
Post Office Box 235
Ruffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 12/2 - 6 B #1 534 see DUP

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤3	Terbium		Ruthenium		Vanadium	0.2
Thorium		Gadolinium		Molybdenum	10	Titanium	4
Bismuth		Europium		Niobium		Scandium	<0.1
Lead	≤2	Samarium		Zirconium	3	Calcium	110
Thallium		Neodymium		Yttrium		Potassium	37
Mercury	NR	Praseodymium		Strontium	2	Chlorine	3
Gold		Cerium		Rubidium	0.8	Sulfur	11
Platinum		Lanthanum		Bromine	1	Phosphorus	15
Iridium		Barium	11	Selenium	≤0.7	Silicon	62
Osmium		Cesium	≤0.1	Arsenic	≤0.2	Aluminum	2
Rhenium		Iodine	0.7	Germanium		Magnesium	13
Tungsten		Tellurium		Gallium	≤0.3	Sodium	38
Tantalum		Antimony		Zinc	3	Fluorine	=11
Hafnium		Tin	≤0.9	Copper	2	Oxygen	NR
Lutetium		Indium	STD	Nickel	2	Nitrogen	NR
Ytterbium		Cadmium	≤0.7	Cobalt	0.1	Carbon	NR
Thulium		Silver	≤0.4	Iron	24	Boron	3
Erbium		Palladium		Manganese	0.6	Beryllium	
Holmium		Rhodium		Chromium	3	Lithium	0.1
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.4ppm weight

Approved: M Jacobs

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucib
prior to analysis

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 230 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9221

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 12/2 - 6 B #2 534

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤3	Terbium		Ruthenium		Vanadium	0.2
Thorium		Gadolinium		Molybdenum	4	Titanium	4
Bismuth		Europium		Niobium		Scandium	<0.1
Lead	≤2	Samarium		Zirconium	1	Calcium	57
Thallium		Neodymium		Yttrium		Potassium	46
Mercury	NR	Praseodymium		Strontium	0.5	Chlorine	5
Gold		Cerium	≤0.5	Rubidium	0.1	Sulfur	23
Platinum		Lanthanum	≤0.9	Bromine	≤0.8	Phosphorus	29
Iridium		Barium	9	Selenium		Silicon	57
Osmium		Cesium		Arsenic	≤0.2	Aluminum	2
Rhenium		Iodine	0.6	Germanium		Magnesium	11
Tungsten		Tellurium	≤0.7	Gallium	≤0.3	Sodium	110
Tantalum		Antimony		Zinc	8	Fluorine	=13
Hafnium		Tin	≤0.8	Copper	4	Oxygen	NR
Lutetium		Indium	STD	Nickel	2	Nitrogen	NR
Ytterbium		Cadmium	≤0.5	Cobalt	<0.1	Carbon	NR
Thulium		Silver	2	Iron	14	Boron	2
Erbium		Palladium		Manganese	0.4	Beryllium	
Holmium		Rhodium		Chromium	2	Lithium	0.1
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.4 ppm weight

Approved: M. Jacobs

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz cruc

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 918 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 738-0404
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9221

Re[illegible] to

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810
Sample No.: 12/2-6 B $\frac{\#1 + \#2}{2}$ 534

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	< 3	Terbium		Ruthenium		Vanadium	0.2
Thorium		Gadolinium		Molybdenum	7	Titanium	4
Bismuth		Europium		Niobium		Scandium	< 0.1
Lead	< 2	Samarium		Zirconium	2	Calcium	84
Thallium		Neodymium		Yttrium		Potassium	42
M[illegible]ury	NR	Praseodymium		Strontium	1.3	Chlorine	4
Gold		Cerium	< 0.45	Rubidium	0.45	Sulfur	17
Platinum		Lanthanum	< 0.65	Bromine	< 0.9	Phosphorus	22
Iridium		Barium	10	Selenium	< 5.5	Silicon	60
Osmium		Cesium	< .25	Arsenic	< 0.2	Aluminum	2
Rhenium		Iod[illegible]ne	0.65	Germanium		Magnesium	12
Tungsten		Tellurium	< 0.55	Gallium	< 0.3	Sodium	74
Tantalum		Antimony		Zinc	5.5	Fluorine	12
Hafnium		Tin	< 0.75	Copper	3	Oxygen	NR
Lutetium		Indium	STD	Nickel	2	Nitrogen	NR
Ytterbium		Cadmium	< 0.6	Cobalt	< 0.1	Carbon	NR
Thulium		Silver	< 1.2	Iron	19	Boron	2.5
Er[illegible]um		Palladium		Manganese	0.5	Beryllium	
Holmium		Rhodium		Chromium	2.5	Lithium	0.1
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.4 ppm weight.

Approved: M Y Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 630 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-0434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14286 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9321

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, New York 14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 12/2-6 C ; 343, 344, 345, 350, 352, 527, 511, 512, 513, 514, 515, 3/24/77 ED

IAD No.: 97-A197-134-31

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.03	Terbium		Ruthenium		Vanadium	0.001
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.04
Bismuth	≤0.007	Europium		Niobium		Scandium	≤0.002
Lead	≤0.02	Samarium		Zirconium	0.005	Calcium	5
Thallium		Neodymium		Yttrium		Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.03	Chlorine	0.2
Gold		Cerium	0.004	Rubidium	≤0.001	Sulfur	MC
Platinum		Lanthanum	0.009	Bromine	0.01	Phosphorus	0.5
Iridium		Barium	0.1	Selenium	≤0.01	Silicon	1
Osmium		Cesium	≤0.002	Arsenic	≤0.002	Aluminum	0.08
Rhenium		Iodine	0.006	Germanium		Magnesium	0.6
Tungsten		Tellurium		Gallium		Sodium	MC
Tantalum		Antimony	≤0.007	Zinc	0.2	Fluorine	≈0.06
Hafnium		Tin		Copper	0.04	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.06	Nitrogen	NR
Ytterbium		Cadmium	≤0.006	Cobalt	0.003	Carbon	NR
Thulium		Silver	320	Iron	0.2	Boron	0.004
Erbium		Palladium		Manganese	0.009	Beryllium	
Holmium		Rhodium		Chromium	0.02	Lithium	0.005
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.004 µg/ml

Approved: M Stacoles

KVB ANALYSIS DATA

SAMPLE	POM's	PCB's
12/2 - 3 B	< 10 ug/l	< 1 ug/l
12/2 - 6 E	10 ug/l	< 1 ug/l
13/18 M	2480 ug/l	< 10 ug/l
13/18 M deep	2890 ug/l	< 10 ug/l
13/18 N	225 ug/l	< 10 ug/l
13/24 609	234 ug/l	< 10 ug/l
13/24 A	10 ug/l	< 5 ug/l
14 616	27 ug/l	< 10 ug/l

12/2-3 B	374, 376, 377
12/2-6 E	343-345, 350
13/18 M	605, 606, 607, 333
13/18 N	264, 331
13/24 A	476, 610, 608, 611, 482, 488, 494

KVB Analysis Data

Test	Sample Number	POM's	PCB's
12/2-3	298	< 1 ug/g	< 1 ug/g
12/2-6	534	< 1 ug/g	< 1 ug/g
	534 (duplicate)	< 1 ug/g	< 1 ug/g
13-18	740	90 ug/g	< 1 ug/g
13-18	282	49 ug/g	< 1 ug/g
13-18	530	3.2 ug/g	< 1 ug/g
13-18	1038	6.3 ug/g	< 1 ug/g
13-18	1032	396 ug/g	< 1 ug/g
13-18	1033	1 ug/g	< 1 ug/g
13-18	1034	8 ug/g	< 1 ug/g
13-18	1034 (duplicate)	9 ug/g	< 1 ug/g
13-24	735	513 ug/g	< 1 ug/g
	531	6.9 ug/g	< 1 ug/g
	1039	20 ug/g	< 1 ug/g
	1035	144 ug/g	< 1 ug/g
	1036	10 ug/g	< 1 ug/g
	1037	7.1 ug/g	< 1 ug/g
	1037 (duplicate)	8.5 ug/g	< 1 ug/g
14	556	70.5 ug/g	< 1 ug/g
	568	104 ug/g	< 1 ug/g
	532	10.7 ug/g	< 1 ug/g
	532 (duplicate)	8.2 ug/g	< 1 ug/g
15-10	1041	< 0.1 ug/g	< 1 ug/g
	1041 (duplicate)	< 0.1 ug/g	< 1 ug/g
	1042	*	*
15-11	941	< 1 ug/l	< 1 ug/l
	1044	< 0.1 ug/g	< 1 ug/g
	1045	*	*
19-1	LF	*	*
19-2	533	< 0.1 ug/g	< 1 ug/g
	533 (duplicate)	< 0.1 ug/g	< 1 ug/g
	C	< 1 ug/l	< 1 ug/l
	C (duplicate)	< 1 ug/l	< 1 ug/l
	LF	*	*

*Sample extracts too concentrated to be able to determine an analytical value.

WOOD-BARK BOILER

Location No. 13 Unit No. 5

Unit Description Wood - Bark Boiler
45,400 kg/hr (100,000 lb/hr)

Installation Date 1966

Heater Rating

Burner Description Detroit Spreader Stoker With
Under Grate And Overfire Air

Test Fuel Combinations Wood - Bark And Coal

Fuel Temp. at Burner (°F) Ambient

Primary Air Temp. (°F) 489K (420°F)

Comments:

MOBILE LABORATORY DATA Test No. _____

Test No. 13 Date 11-2-76 Location 13 Engr. R.W.N.

Unit No. 5 Fuel COAL + BARK Capacity 100,000 lbs/Hr.

Unit Type WICKS W.T. Burner Type DETROIT STOKER

1. Test No.	13-1		13-2		13-3		13-4		13-5	
2. Date	11-2-76		11-2-76		11-2-76		11-2-76		11-2-76	
3. Time	0842		0947		1223		1335		1410	
4. Load (lb/Hr STEAM)	93K		91K		90K		89K		94K	
5. Process Rate	—		—		—		—		—	
6. Flue Diam. or Size, ft	10.5 x 9.7									
7. Probe Position										
8. Oxygen (%)	7.7		6.9		8.5		7.8		7.5	
9. NOx (hot) read/3% O_2 (ppm)	160	217	178	227	240	346	190	259	193	257
10. NO (hot) read/3% O_2 (ppm)	155	210	168	214	240	346	198	270	190	253
11. NO_2 (hot) read/3% O_2 (ppm)	5	7	10	13	0	0	—	—	3	4
12. NO (cold) read/3% O_2 (ppm)	191	258	206	263	255	367	213	290	218	291
13. Carbon Dioxide (%)	10.4		—		—		—		—	
14. Carbon Monoxide (ppm) uncor/cor	—	—	30	38	6	9	22	30	24	32
15. Hydrocarbon (ppm) uncor/cor	20	27	10	13	0	0	0	0	0	0
16. Sulfur Dioxide (ppm) uncor/cor	680	920	1090	1391	1340	1930	900	1227	810	1173
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/DRY BULB)	49		50		52		53		55	
19. Dew Point Temp. (°F/WB)	42		40		45		43		40	
20. Atmos. Pressure (in. Hg)			29.90		29.87		29.86		29.83	
21. Relative Humidity (%)	56		40		58		43		21	
22.										
23.										
24.										
25.										
26.	BASELINE		BASELINE		BASELINE NO BARK		BASELINE 5% O_2		BASELINE 5% O_2	
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 13 Date _____ Location NO 13 Engr. _____

Unit No. 5 Fuel COAL + BARK Capacity 100,000 lbs/Hr

Unit Type WICKS W.T. Burner Type DETROIT STOKER

1. Test No.	13-6		13-7		13-8							
2. Date	11-8-76		11-3-76		11-3-76							
3. Time	0900		1049		1442							
4. Load (lb/Hr STEAM)	87,000		90,000		90,000							
5. Process Rate	—		—		—							
6. Flue Diam. or Size, ft	10.5 x 9.7		10.5 x 9.7		10.5 x 9.7							
7. Probe Position	CENTER		CENTER		CENTER							
8. Oxygen (%)	8.5		8.4		7.9							
9. NOx (hot) read/3% O_2 (ppm)	205	295	170	243	183	251						
10. NO (hot) read/3% O_2 (ppm)	205	295	168	240	171	235						
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	2	3	12	16						
12. NO (cold) read/3% O_2 (ppm)	230	331	188	269	204	280						
13. Carbon Dioxide (%)	—		—		—							
14. Carbon Monoxide (ppm) uncor/cor	96	138	48	69	48	66						
15. Hydrocarbon (ppm) uncor/cor	0	0	7	10	0	0						
16. Sulfur Dioxide (ppm) uncor/cor	820	1181	750	1071	800	1099						
17. Smoke Spot (Bacharach)	—		—		—							
18. Atmos. Temp. (°F/[redacted]	36		39		36							
19. Dew Point Temp. (°F/[redacted]	31		34		30							
20. Atmos. Pressure (in. Hg)	29.80		29.79		29.85							
21. Relative Humidity (%)	56		60		49							
22.												
23.												
24.												
25.												
26.	BASE LINE PART-6		BASELINE PRETREATED		BRINK BASE LINE							
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 13-3 Date 11-4-76 Location 13 Engr. B W H

Unit No. 5 Fuel COAL & BARK Capacity 100,000 lbs/hr

Unit Type WICKS W.T. Burner Type DETROIT STOKER

1. Test No.	13-9		13-10		13-11		13-12		13-13	
2. Date	11-4-76		11-4-76		11-4-76		11-4-76		11-4-76	
3. Time	0835		0930		1000		1045		1335	
4. Load	91,000		91,000		88,000		97,000		85,000	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	7.75		9.6		8.75		5.3		~6.8	
9. NOx (hot) read/3% O_2 (ppm)	190	258	233	368	215	316	190	218	170	216
10. NO (hot) read/3% O_2 (ppm)	188	255	240	379	215	316	188	216	170	216
11. NO_2 (hot) read/3% O_2 (ppm)	2	3	0	0	0	0	2	2	0	0
12. NO (cold) read/3% O_2 (ppm)	225	306	258	407	230	338	233	267	200	254
13. Carbon Dioxide (%)	—		—		—		—		1005	
14. Carbon Monoxide (ppm) uncor/cor	32	43	64	101	94	65	10	12	12	15
15. Hydrocarbon (ppm) uncor/cor	6	8	4	6	7	10	3	3	3	4
16. Sulfur Dioxide (ppm) uncor/cor	810	1100	980	1547	960	1411	1240	1422	1100	1594
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. ~~Atmos. Temp.~~ DRY BULB (°F)°C)	37		35.5		36		37		40	
19. Dew Point Temp. (°F)°C)	35		34		34		34		36	
20. Atmos. Pressure (in. Hg)	30.04		30.04		30.05		30.06		30.05	
21. Relative Humidity (%)	93		86		82		75		67	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 13-3

Test No. 13-3 Date 11-4-76 Location 13 Engr. N. BUENING

Unit No. 5 Fuel COAL + BARK Capacity 100,000 lbs/hr

Unit Type WICKES W.T. Burner Type DETROIT STOKER

1. Test No.	13-14		13-15									
2. Date	11-4-76		11-4-76									
3. Time	1425		1540									
4. Load lbs/hr	25,000		89,000									
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position												
8. Oxygen (%)	~7.9		~7.4									
9. NOx (hot) read/3% O_2 (ppm)	190	241	170	225								
10. NO (hot) read/3% O_2 (ppm)	190	241	170	225								
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	0	0								
12. NO (cold) read/3% O_2 (ppm)	235	323	200	265								
13. Carbon Dioxide (%)	10CS		10CS									
14. Carbon Monoxide (ppm) uncor/cor	40	55	0	C								
15. Hydrocarbon (ppm) uncor/cor	0	0	0	0								
16. Sulfur Dioxide (ppm) uncor/cor	1080	1489	1060	1405								
17. Smoke Spot (Bacharach)	NA		NA									
18. ~~Atmos. Temp.~~ DRY BULB (°F)°C)	38		39									
19. ~~Dew Point Temp.~~ WET BULB (°F)°C)	34		35									
20. Atmos. Pressure (in. Hg)	30.04		30.03									
21. Relative Humidity (%)	66		67									
22.												
23.												
24.												
25.												
26.	BASELINE O2 SWING + OVERFIRE AIR		30% OVER FIRE AIR									
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 13 Date 11-8-76 Location 13 Engr. _____

Unit No. 5 Fuel COAL + BARK Capacity 100 K #/Hr

Unit Type WICKES W.T. Burner Type DETROIT STOKER

1. Test No.	13-16		13-17		13-18		13-18		13-18	
2. Date	11-8-76		11-8-76		11-9-76		11-9-76		11-9-76	
3. Time	1410		1515		1116		1330		1540	
4. Load (10^3 lb/hr STEAM)	85		86		91		90		90	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	CENTER		CENTER		CENTER		CENTER		CENTER	
8. Oxygen (%)	8.0		6.75		8.4		8.4		8.5	
9. NOx (hot) read/3% O_2 (ppm)	180	249	135	171	170	243	173	247	170	245
10. NO (hot) read/3% O_2 (ppm)	172	238	135	171	169	241	168	240	165	238
11. NO_2 (hot) read/3% O_2 (ppm)	8	11	0	0	1	2	5	7	5	7
12. NO (cold) read/3% O_2 (ppm)	217	300	153	193	200	286	195	279	203	292
13. Carbon Dioxide (%)	—		—		—		—		—	
14. Carbon Monoxide (ppm) uncor/cor	100	138	76	96	180	257	180	257	195	281
15. Hydrocarbon (ppm) uncor/cor	0	0	0	0	3	4	5	7	3	4
16. Sulfur Dioxide (ppm) uncor/cor	810	1122	660	859	480	686	560	800	660	950
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C) DRY BULB	29		32		39		42		42	
19. Dew Point Temp. (°F/°C)	26		28		34		37		37	
20. Atmos. Pressure (in. Hg)	30.04		29.80		29.48		29.47		29.50	
21. Relative Humidity (%)					60		63		63	
22.										
23.										
24.										
25.										
26.	BASELINE		LOW O_2 PARTIC. TEST		BASELINE SASS		BASELINE SASS		BASELINE SASS	
27										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 13 Date 11-10-76 Location 13 Engr._____

Unit No. 5 Fuel COAL + BARK Capacity 100K #/HR.

Unit Type WICKES W.T. Burner Type DETROIT STOKER

1. Test No.	13-19		13-20		13-21		13-22		13-23	
2. Date	11-10-76		11-10-76		11-10-76		11-10-76		11-10-76	
3. Time	0850		1100		1320		1440		1510	
4. Load (10^3 lb/hr STEAM)	87		86		94		92		91	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	CENTER		CENTER		CENTER		CENTER		CENTER	
8. Oxygen (%)	8.25		7.4		7.3		7.25		8.6	
9. NOx (hot) read/3% O_2 (ppm)	193	242	133	176	145	191	171	224	183	266
10. NO (hot) read/3% O_2 (ppm)	193	202	130	172	145	191	171	224	180	261
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	3	4	0	0	0	0	3	5
12. NO (cold) read/3% O_2 (ppm)	168	237	155	205	175	230	193	253	195	253
13. Carbon Dioxide (%)	—		—		—					
14. Carbon Monoxide (ppm) uncor/cor	150	212	100	132	105	138	90	118	170	246
15. Hydrocarbon (ppm) uncor/cor	1	1	1	1	0	0	0	0	0	0
16. Sulfur Dioxide (ppm) uncor/cor	850	1200	900	1191	940	1235	880	1152	880	1277
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (DRY BULB °F/°C)	30		31		33		—		33	
19. Dew Point Temp. (°F/°C)	32		—		31		—		31	
20. Atmos. Pressure (in. Hg)	29.84		29.84		29.85		29.84		29.84	
21. Relative Humidity (%)	—		—		81		—		81	
22.										
23.										
24.										
25.										
26. BASELINE			LOW O_2		OPTIMIZATION LOW O_2		OPTIMIZATION LOW O_2 + REDUCED OVER FIRE AIR		BASELINE COMBINATION	
27.			ERRATIC							
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 13 Date 11-10-76 Location 13 Engr. _____

Unit No. 5 Fuel COAL & GAS Capacity 100 K lb/Hr

Unit Type WICKES W.T. Burner Type DETROIT STOKER

1. Test No.	13-19		13-20		13-21		13-22		13-23	
2. Date	11-10-76		11-10-76		11-10-76		11-10-76		11-10-76	
3. Time	0850		1100		1320		1440		1510	
4. Load (10^3 lb/Hr STEAM)	87		86		94		92		91	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	CENTER		CENTER		CENTER		CENTER		CENTER	
8. Oxygen (%)	8.25		7.4		7.3		7.25		8.6	
9. NOx (hot) read/3% O_2 (ppm)	143	202	133	176	145	191	171	224	193	266
10. NO (hot) read/3% O_2 (ppm)	143	202	130	172	145	191	171	224	190	261
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	3	4	0	0	0	0	3	5
12. NO (cold) read/3% O_2 (ppm)	168	237	155	205	175	230	193	253	195	263
13. Carbon Dioxide (%)	—		—		—					
14. Carbon Monoxide (ppm) uncor/cor	150	212	100	132	105	138	90	118	170	246
15. Hydrocarbon (ppm) uncor/cor	1	1	1	1	0	0	0	0	0	0
16. Sulfur Dioxide (ppm) uncor/cor	850	1200	900	1191	940	1235	830	1152	880	1277
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C) DRY BULB	30		31		33		—		33	
19. Dew Point Temp. (°F/°C)	32		—		31		—		31	
20. Atmos. Pressure (in. Hg)	29.84		29.84		29.85		29.84		29.84	
21. Relative Humidity (%)	—		—		81		—		81	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

BASELINE

LOW O_2 BURNER

OPTIMIZATION LOW O_2

OPTIMIZATION LOW O_2 - REDUCED OVER FIRE AIR

BASE LINE CONDITION

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 13 Date 11-11-76 Location 13 Engr. _____

Unit No. 5 Fuel COAL & BARK Capacity 100 K#/Hr

Unit Type WICKES W.T. Burner Type DETROIT STOKER

1. Test No.	13-24		13-24		13-24							
2. Date	11-11-76		11-11-76		11-11-76							
3. Time	1000		1250		1430							
4. Load	88,000		90,000		87,000							
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	CENTER		CENTER		CENTER							
8. Oxygen (%)	8.75		8.25		8.4							
9. NOx (hot) read/3% O_2 (ppm)	174	256	156	220	184	263						
10. NO (hot) read/3% O_2 (ppm)	173	254	156	220	184	263						
11. NO_2 (hot) read/3% O_2 (ppm)	1	2	0	0	0	0						
12. NO (cold) read/3% O_2 (ppm)	185	287	190	268	195	279						
13. Carbon Dioxide (%)	—		—		—							
14. Carbon Monoxide (ppm) uncor/cor	150	220	110	254	140	200						
15. Hydrocarbon (ppm) uncor/cor	0	0	0	0	0	0						
16. Sulfur Dioxide (ppm) uncor/cor	720	1058	520	734	820	1171						
17. Smoke Spot (Bacharach)	—		—		—							
18. Atmos. Temp. (°F)°C)	24		27		27							
19. Dew Point Temp. (°F/°C)	—		—		—							
20. Atmos. Pressure (in. Hg)	30.09		30.09		30.10							
21. Relative Humidity (%)	—		—		—							
22.												
23.												
24.												
25.	SASS TEST BASELINE		SASS TEST BASELINE		SASS TEST BASELINE							
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

OPERATING DATA

Location 13

Test	13/1	13-2	13-3	13-4	13-5
Date	11-2-76	11-2-76	11-2-76	11-2-76	11-2-76
Time	0845	0947	1222	1330	1410
Steam Flow, lbs/hr	93000	91,000	90,000	89,000	94000
Air Flow	93000	90,000	90,000	89,000	94000
Steam Temp., °F	770	770	721	780	755
F.W. Flow (lbs/hr)/F.W. Temp. (°F)	93000 / 252	110000 / 252	90,000 / 252	110,000 / 252	105000 / 252
Air Temp. entering A.H., °F	68	69	60	70	70
Air Temp. leaving A.H., °F	410	412	395	421	410
Gas Temp. leaving Blr, °F	540	537	530	540	538
Gas Temp. leaving A.H., °F	410	408	400	415	408
F.W. Pressure, psig	1090	1090	1090	1090	1090
Steam Header Pressure, psig	600	600	600	600	600
S.H. Metal Temp., °F	794	803	744	797	784
F.D. Fan Press., in. H_2O	2.2	2.2	2.6	2.05	2.05
A.H. Outlet Press., in. H_2O	1.9	1.7	2.0	1.8	1.8
Plenum Press., in. H_2O	.6	.65	.8	.75	.75
Overfire Air Press., in. H_2O	19	19.0	19.0	19.0	19.0
Furnace Draft, in. H_2O	-.1	-.1	-.1	-.1	-.1
Boiler Outlet Draft, in. H_2O	-1.1	-1.0	-1.1	-1.0	-1.1
A.H. Outlet Draft, in. H_2O	-2.0	-1.8	-1.9	-2.0	-2.0
Classifier Outlet, in. H_2O	-2.0	-2.0	-2.0	-2.0	-2.0
Dust Collector Outlet, in. H_2O	-6.3	-6.0	-6.7	-6.2	-6.4
I.D. Fan Inlet, in. H_2O	-10.0	-10.0	-10.0	-10.0	-10.0
Bark Distribution Air, in. H_2O	17.5	17.5	17.5	17.5	17.5
East Grate Temp., °F	400	400	400	400	400
West Grate Temp., °F	385	385	385	395	385
Bark Screw (% max. RPM)	21.5	21.5	0	21	21
Overfire Air Damper % Open	100	100	100	100	100
Excess Air Setpoint	50	50	49	49	49
Furnace Draft Setpoint	51	52	51	51	50
Stoker Rotor Contr. Setpoint	73	73	72	72	73
Steam Flow Integrator, lbs/hr x 125000	173293	173375	173554	173635	173684
Opacity, %	38	37	30	30½ 48	35
Grate Speed (indic.)	47 FAST	47 FAST	48	48	48
	BASELINE	BASELINE	BASELINE WITHOUT BARK	BASELINE 50%	BASELINE 50%

OPERATING DATA

Location 13

Test	13-6	13-7	13-8	13-9	13-10
Date	11-3-76	11-3-76	11-3-76	11-4-76	11-4-76
Time	0905	1145	1445	0841	0928
Steam Flow, lbs/hr	87,000	90,000	90,000	91,000	91,000
Air Flow	88,000	90,000	93,000	89,000	108,000
Steam Temp., °F	735	795	770	768	768
F.W. Flow (lbs/hr)/F.W. Temp. (°F)	85,000 | 252	105,000 | 252	110,000 | 252	95,000 | 253	85,000 | 252
Air Temp. entering A.H., °F	64	65	68	63	63
Air Temp. leaving A.H., °F	415	430	422	420	400
Gas Temp. leaving Blr, °F	680	549	547	540	545
Gas Temp. leaving A.H., °F	402	420	420	411	405
F.W. Pressure, psig	1100	1100	1100	1090	1090
Steam Header Pressure, psig	600	600	600	600	600
S.H. Metal Temp., °F	753	817	805	799	795
F.D. Fan Press., in. H_2O	1.7	2.0	2.0	2.0	3.0
A.H. Outlet Press., in. H_2O	1.4	1.8	1.5	1.6	2.6
Plenum Press., in. H_2O	.4	.5	.6	.5	.8
Overfire Air Press., in. H_2O	18	18	18	18	18
Furnace Draft, in. H_2O	-.18	-.18	-.18	-.04	-.08
Boiler Outlet Draft, in. H_2O	-1.1	-1.25	-1.2	-1.1	-1.3
A.H. Outlet Draft, in. H_2O	-1.6	-2.0	-1.8	-1.8	-2.0
Classifier Outlet, in. H_2O	-1.8	-2.2	-2.1	-1.8	-2.2
Dust Collector Outlet, in. H_2O	-5.5	-7.0	-6.5	-6.1	-7.1
I.D. Fan Inlet, in. H_2O	-10	-10	-10	-10	-10
Bark Distribution Air, in. H_2O	16	16	14	14	16
East Grate Temp., °F	400	400	400	400	400
West Grate Temp., °F	385	385	385	385	385
Bark Screw (% max. RPM)	26	26	26	24	23.5
Overfire Air Damper % Open	100	100	100	—	—
Excess Air Setpoint	49	49	49	49	40
Furnace Draft Setpoint	50	50	50	51	51
Stoker Rotor Contr. Setpoint	69	70	70	69	69
Steam Flow Integrator, lbs/hr x 12500	174998	175184	175402	176648	176707
Opacity, %	20	28	33	36	28
Grate Speed (indic.)	50 FAST	50 FAST	50 FAST	28 FAST	28 FAST
	BASELINE RATIO	BASELINE RATIO	BASELINE BRIK	BASELINE O_2 SWING	O_2 SWING

OPERATING DATA

Location 13

Test	13-11	13-12	13-13	13-14	13-15
Date	11-4-76	11-4-76	11-4-76	11-4-76	11-4-76
Time	0959	1051	1330	1409	1521
Steam Flow, lbs/hr	88,000	97,000	85,000	85,000	91,000
Air Flow	97,000	80,000	77,000	88,000	89,000
Steam Temp., °F	780	780	768	779	760
F.W. Flow (lbs/hr)/F.W. Temp. (°F)	91,000 / 252	100,000 / 252	100,000 / 252	86,000 / 252	91,000 / 252
Air Temp. entering A.H., °F	63	68	62	68	68
Air Temp. leaving A.H., °F	412	428	427	419	418
Gas Temp. leaving Blr, °F	540	549	534	538	540
Gas Temp. leaving A.H., °F	409	415	412	410	412
F.W. Pressure, psig	1090	1090	1090	1090	1090
Steam Header Pressure, psig	600	600	600	600	600
S.H. Metal Temp., °F	787	799	796	788	792
F.D. Fan Press., in. H_2O	2.3	1.8	1.6	1.7	1.9
A.H. Outlet Press., in. H_2O	1.7	1.5	1.2	1.3	1.6
Plenum Press., in. H_2O	.6	.5	.4	.4	.5
Overfire Air Press., in. H_2O	17.5	19	17	18	24
Furnace Draft, in. H_2O	-.08	-.1	-.06	-.15	-.25
Boiler Outlet Draft, in. H_2O	-1.1	-1.1	-1.1	-1.1	-1.15
A.H. Outlet Draft, in. H_2O	-1.6	-1.8	-1.5	-1.6	-1.9
Classifier Outlet, in. H_2O	-1.8	-1.9	-1.7	-1.6	-1.9
Dust Collector Outlet, in. H_2O	-6.1	-6.0	-5.5	-5.1	-5.6
I.D. Fan Inlet, in. H_2O	-10	-10.0	-10	-10	-10
Bark Distribution Air, in. H_2O	14.5	14	16	14.5	19
East Grate Temp., °F	400	400	—	—	—
West Grate Temp., °F	385	385	—	—	—
Bark Screw (% max. RPM)	28.5	28.5	28.5	28.5	23.5
Overfire Air Damper % Open	—	—	—	—	30
Excess Air Setpoint	45	59	54	50	50
Furnace Draft Setpoint	51	51	51	50	50
Stoker Rotor Contr. Setpoint	69	80	68	68	71
Steam Flow Integrator, lbs/hr x 12500	176738	176803	176994	177058	177123
Opacity, %	25	40	34	28	26
Grate Speed (indic.)	23 FAST	28 FAST	13 FAST	13 FAST	13 FAST
	O_2 SWING	O_2 SWING	O_2 SWING	BASELINE O_2	OVERFIRE AIR

OPERATING DATA

Location 13

Test	13-16	13-17	13-18	13-18	13-18
Date	11-8-76	11-9-76	11-9-76	11-9-76	11-9-76
Time	1423	1628	1126	1332	1555
Steam Flow, lbs/hr	85,000	86000	91000	90 000	90000
Air Flow	83000	62,000	90 000	89000	90000
Steam Temp., °F	755	761	765	765	765
F.W. Flow (lbs/hr)/F.W. Temp. (°F)	92,000 | 252	105,000 | 252	87000 | 252	89,000 | 252	88000 | 252
Air Temp. entering A.H., °F	68	64	72	73	70
Air Temp. leaving A.H., °F	418	440	433	430	429
Gas Temp. leaving Blr, °F	535	530	548	542	541
Gas Temp. leaving A.H., °F	410	420	428	422	422
F.W. Pressure, psig	1100	1100	1100	1100	1100
Steam Header Pressure, psig	590	590	590	590	590
S.H. Metal Temp., °F	801	789	799	792	796
F.D. Fan Press., in. H_2O	1.9	1.2	1.9	2.0	1.8
A.H. Outlet Press., in. H_2O	1.5	.9	1.6	1.3	1.2
Plenum Press., in. H_2O	.7	.5	.5	.4	.4
Overfire Air Press., in. H_2O	17.5	17.5	17	17.5	18
Furnace Draft, in. H_2O	-.1	-.1	-.26	-.35	-.32
Boiler Outlet Draft, in. H_2O	-1.1	-1.0	-1.4	-1.4	-1.4
A.H. Outlet Draft, in. H_2O	-1.9	-1.6	-2.2	-2.2	-2.3
Classifier Outlet, in. H_2O	-2.0	-1.6	-2.6	-2.5	-2.5
Dust Collector Outlet, in. H_2O	-6.5	-5.1	-7.7	-7.2	-7.5
I.D. Fan Inlet, in. H_2O	-10	-10	-10	-10	-10
Bark Distribution Air, in. H_2O	17	17	16	16.5	16.5
East Grate Temp., °F	—	—	—	—	—
West Grate Temp., °F	—	—	—	—	—
Bark Screw (% max. RPM)	26	25.5	28	28	28
Overfire Air Damper % Open	100	100	100	100	100
Excess Air Setpoint	50	65	49	49	49
Furnace Draft Setpoint	51	51	45	45	45
Stoker Rotor Contr. Setpoint	64	70	71	70	70
Steam Flow Integrator, lbs/hr x 125000	183717	183865	185264	185414	185582
Opacity, %	41	50	42	37	39
Grate Speed (indic.)	93 FAST	93 FAST	93 FAST	93 FAST	65 FAST
	BASELINE	PARTIC. LOW O_2	SASS BASELINE	SASS	SASS

OPERATING DATA

Location 13

Test	13-19	13-20	13-21	13-22	13-23
Date	11-10-76	11-10-76	11-10-76	11-10-76	11-10-76
Time	0845	1100	1317	1936	1509
Steam Flow, lbs/hr	87,000	86,000	99,000	92000	91000
Air Flow	83,000	68,000	80,000	74000	94000
Steam Temp., °F	775	763	780	775	781
F.W. Flow (lbs/hr)/F.W. Temp. (°F)	110,000 | 252	100,000 | 252	105,000 | 252	105,000 | 252	105,000 | 252
Air Temp. entering A.H., °F	70	70	70	70	70
Air Temp. leaving A.H., °F	430	446	440	440	430
Gas Temp. leaving Blr, °F	536	535	543	540	549
Gas Temp. leaving A.H., °F	420	446	430	425	428
F.W. Pressure, psig	1090	1090	1090	1090	1090
Steam Header Pressure, psig	600	600	600	600	600
S.H. Metal Temp., °F	814	797	818	794	810
F.D. Fan Press., in. H_2O	1.5	1.2	1.3	1.4	1.9
A.H. Outlet Press., in. H_2O	1.5	1.0	1.1	1.1	1.5
Plenum Press., in. H_2O	.5	.3	.4	.2	.4
Overfire Air Press., in. H_2O	18	18	18	20.5	18
Furnace Draft, in. H_2O	-.3	-.3	-.3	-.32	-.33
Boiler Outlet Draft, in. H_2O	-1.2	-1.5	-1.4	-1.2	-1.5
A.H. Outlet Draft, in. H_2O	-2.4	-2.2	-2.0	-2	-2
Classifier Outlet, in. H_2O	-2.2	-2.2	-2.2	-2	-2.5
Dust Collector Outlet, in. H_2O	-6.9	-6.5	-7.0	-6.3	-7.5
I.D. Fan Inlet, in. H_2O	-10	-10	-10	-10	-10
Bark Distribution Air, in. H_2O	16	15	15	16.5	15
East Grate Temp., °F	—	—	—	—	—
West Grate Temp., °F	—	—	—	—	—
Bark Screw (% max. RPM)	28	28	28	28	28
Overfire Air Damper % Open	100	100	100	100	100
Excess Air Setpoint	52	59	55	60	48
Furnace Draft Setpoint	45	45	45	46	46
Stoker Rotor Contr. Setpoint	66	68	72	73	73
Steam Flow Integrator, lbs/hr x 125000	196729	196991	187060	197150	197189
Opacity, %	39	34	50	38	38
Grate Speed (indic.)	35 FAST	35 FAST	35 FAST	35 FAST	35 FAST
	BASELINE	BRINK LOW O_2	OPTIMIZ LOW O_2	OPTIMIZ LOW O_2 FRONT OVERFIRE AIR 10% OPEN	BASELINE

OPERATING DATA

Location 13

Test	13-24	13-24	13-24		
Date	11-11-76	11-11-76	11-11-76		
Time	1015	1252	1430		
Steam Flow, lbs/hr	88,000	90,000	87,000		
Air Flow	84,000	88,000	85,000		
Steam Temp., °F	775	790	775		
F.W. Flow (lbs/hr)/F.W. Temp. (°F)	103000 / 252	105000 / 252	105000 / 252		
Air Temp. entering A.H., °F	62	61	62		
Air Temp. leaving A.H., °F	435	439	438		
Gas Temp. leaving Blr, °F	541	550	546		
Gas Temp. leaving A.H., °F	427	432	428		
F.W. Pressure, psig	1100	1100	1100		
Steam Header Pressure, psig	590	590	590		
S.H. Metal Temp., °F	806	821	801		
F.D. Fan Press., in. H_2O	1.5	1.8	1.6		
A.H. Outlet Press., in. H_2O	1.6	1.6	1.6		
Plenum Press., in. H_2O	.3	.3	.4		
Overfire Air Press., in. H_2O	17	17	17		
Furnace Draft, in. H_2O	-.3	-.3	-.35		
Boiler Outlet Draft, in. H_2O	-1.4	-1.4	-1.4		
A.H. Outlet Draft, in. H_2O	-2.5	-2.6	-2.4		
Classifier Outlet, in. H_2O	-2.5	-2.6	-2.5		
Dust Collector Outlet, in. H_2O	-7	-7.9	-7.6		
I.D. Fan Inlet, in. H_2O	-10	-10	-10		
Bark Distribution Air, in. H_2O	16.5	19	15		
East Grate Temp., °F	—	—	—		
West Grate Temp., °F	—	—	—		
Bark Screw (% max. RPM)	27.5	28.5	28.5		
Overfire Air Damper % Open	—	—	—		
Excess Air Setpoint	31	31	31		
Furnace Draft Setpoint	46	46	46		
Stoker Rotor Contr. Setpoint	70	71	71		
Steam Flow Integrator, lbs/hr x 125000	188510	189489	189812		
Opacity, %	42	45	50		
Grate Speed (indic.)	34 FAST	34 FAST	34 FAST		

LOCATION 13

Woodbark Fuel and Bottom Ash Analyses

	Woodbark EASS Test Test 13-18 (1032) 11-9-76		Woodbark EASS Test Test 13-24 (1035) 11-11-76	
	As Received	Dry	As Received	Dry
Proximate Analysis:				
Moisture, %	60.91	--	51.71	--
Volatile Matter, %	27.79	71.10	36.66	75.92
Ash, %	3.05	7.80	1.85	3.84
Fixed Carbon, %	8.25	21.10	9.78	20.24
Ultimate Analysis:				
Moisture, %	60.91	--	51.71	--
Carbon, %	18.71	47.87	24.40	50.53
Hydrogen, %	2.20	5.62	2.94	6.09
Nitrogen, %	0.21	0.53	0.18	0.37
Sulfur, %	0.08	0.21	0.03	0.07
Ash, %	3.05	7.80	1.85	3.84
Oxygen, % (by difference)	14.84	37.97	18.89	39.10
Heat of Combustion:				
Gross BTU/lb	3219	8234	4065	8418
Net BTU/lb	3015	7713	3793	7854

	Bottom Ash Test 13-18 (1033) 11-9-76 EASS Test	Bottom Ash Test 13-24 (1036) 11-11-76 EASS Test
Carbon, %	6.04	2.08
Gross Heat of Combustion, BTU/lb	34	12 *

* Not an experimental result. Value was calculated from the ratio of the two carbon assays and the BTU analysis of the sample marked "Test 13-18".

LOCATION 13

Coal Fuel Analyses

	Test 13-18 11-09-76	Test 13-24 11-11-76
Ultimate Analysis:		
Carbon, %	66.93	64.42
Hydrogen, %	4.93	4.88
Nitrogen, %	1.49	1.33
Sulfur, %	2.47	2.80
Ash, %	7.66	8.32
Oxygen, % (by difference)	16.52	18.25
Proximate Analysis:		
Moisture, %	7.35	7.50
Ash, %	7.66	8.32
Volatile Matter, %	46.15	46.26
Fixed Carbon, %	38.84	37.92
Heat of Combustion:		
Gross BTU/lb	11,970	11,730
Net BTU/lb	11,510	11,280

PARTICULATE EMISSION CALCULATIONS

Test No. 13-6 Date 11-8-76 Location 13 Engr. _____

Unit No. 5 Fuel Coal + Gas Sampling Train and Method MODIFIED #5

Pitot Factor, Fs .84 Barometric Pressure, P_{bar} 29.79 in. Hg

Tot. Liquid Collected, V_{lc} 101.1 ml ~~GAIN~~ SOLID Particulate, M_n 383.5 m gm

Velocity Head, ΔP .035 iwg Stack Temp., Ts 861 °R Stack Area, As 49.35 ft^2

Sample Volume, Vm 60 ft^3 Stack Press., Psg -.25 iwg Excess O_2, XO_2% 5.4 %

Orifice Press. Diff., H .69 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 98 min Nozzle Dia., Dn 1/2 in. Meter Temp., T_m _____ °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	59.8	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	4.79	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.074	M.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	.0988	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	1.414×10^{-5}	lb/DSCF
	c. C = Eq. 4b x 16.018 x 10^3	2.269×10^{-1}	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	404.89	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	804.44	ft/min
7. Stack Gas Flow Rate @ 70°F	a. Qsv = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	24310	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	22511	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	19.1	lb/hr
9. XO_2 factor	$XO_2 f = 2090/(20.9 - XO_2\%)$	167.2	M.D.
10. Emission	a. E = Eq. 4b x Fs x Eq. 9	.241	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	103.72	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	104.5	%

	Oil	Gas	Coal
Fs SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$ (°R) if meter not temp. compensated.

Data Sheet 6002-4

Fc = 102.056

F_a = .002740

PARTICULATE EMISSION CALCULATIONS

Test No. 13-6 Date 11-3-76 Location 13 Engr. _____

Unit No. 5 Fuel COAL + BARK Sampling Train and Method MODIFIED #5

Pitot Factor, Fs .84 Barometric Pressure, P_{bar} 29.79 in. Hg

Tot. Liquid Collected, V_{lc} 101.1 ml Total Particulate, M_n 615.7 m gm

Velocity Head, ΔP .035 iwg Stack Temp., Ts 861 °R Stack Area, As 49.35 ft^2

Sample Volume, Vm 60 ft^3 Stack Press., Psg -.25 iwg Excess O_2, XO_2% 8.4 %

Orifice Press. Diff., H .69 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 92 min Nozzle Dia., Dn ½ in. Meter Temp., T_m _____ °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	59.8	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	4.79	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.074	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	.1586	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	2.27×10^{-5}	lb/DSCF
	c. C = Eq. 4b x 16.018×10^{3}	3.635×10^{-1}	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	404.89	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	804.44	ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	24310	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	22511	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	30.66	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	167.2	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	.3849	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	166.52	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	104.5	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

Fe = 102.056

Fm = .002740

PARTICULATE EMISSION CALCULATIONS

Test No. 13-17 Date 11-9-76 Location 13 Engr. _____

Unit No. 5 Fuel COAL + BARK Sampling Train and Method JOY METHOD #5

Pitot Factor, Fs .84 Barometric Pressure, P_{bar} 29.80 in. Hg

Tot. Liquid Collected, V_{lc} 171.3 ml Total ~~Particulate~~, M_n 708.3 m gm

Velocity Head, ΔP .04 iwg Stack Temp., Ts 869 °R Stack Area, As 49.35 ft^2

Sample Volume, Vm 60 ft^3 Stack Press., Psg -.25 iwg Excess O_2, XO_2% 6.75 %

Orifice Press. Diff., H .86 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 87 min Nozzle Dia., Dn 1/2 in. Meter Temp., T_m _____ °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	59.85	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	8.12	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.119	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	.1823	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	2.61×10^{-5}	lb/DSCF
	c. C = Eq. 4b x 16.018×10^{3}	4.16×10^{-1}	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	405.03	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	863.82	ft/min
7. Stack Gas Flow Rate @ 70°F	a. Qsw = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	25874	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	22795	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	35.7	lb/hr
9. XO_2 factor	$XO_2 f = 2090/(20.9 - XO_2\%)$	147.7	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	.396	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	169.572	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	109.26	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

BARK 19% OF LOAD

Fe = 102.78

F_m = .002759

PARTICULATE EMISSION CALCULATIONS

Test No. 13-17 Date 11-9-76 Location 13 Engr. _____

Unit No. 5 Fuel COAL + BARK Sampling Train and Method 304 TRAIN METHOD 5

Pitot Factor, Fs .84 Barometric Pressure, P_{bar} 29.8 in. Hg

Tot. Liquid Collected, V_{lc} 171.5 ml Total Particulate, M_n 890.5 m gm

Velocity Head, ΔP .04 iwg Stack Temp., Ts 869 °R Stack Area, As 49.35 ft^2

Sample Volume, Vm 60 ft^3 Stack Press., Psg -.25 iwg Excess O_2, XO_2% 6.75 %

Orifice Press. Diff., H .86 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 87 min Nozzle Dia., Dn 1/2 in. Meter Temp., T_m _____ °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	59.85	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	8.12	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.119	N.D.
4. Concentration a.	$C = 0.0154\ Mn/Vm_{std}$	.2292	grains/DSCF
b.	$C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	3.28×10^{-3}	lb/DSCF
c.	$C = \text{Eq. 4b} \times 16.018 \times 10^{3}$	5.23×10^{-1}	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	405.03	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	863.82	ft/min
7. Stack Gas Flow Rate @ 70°F a.	$Qsw = \text{Eq. 6} \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	25874	WSCF/min
b.	Qsd = Eq. 7a x (1. - Eq. 3)	22795	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	44.88	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	147.7	N.D.
10. Emission a.	E = Eq. 4b x Fe x Eq. 9	.498	lb/MMBtu
b.	E = Eq. 4c x Fm x Eq. 9 x 1000	213.13	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	109.26	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS SASS

Test No. 13-18 Date 11/9/76 Location 13 Engr. SCH

Unit No. _____ Fuel Coal/Wood Sampling Train and Method _____

Pitot Factor, Fs 0.85 Barometric Pressure, P_{bar} 29.48 in. Hg

Tot. Liquid Collected, V_{lc} 890 ml Total Particulate, M_n 3096.9 m gm

Velocity Head, ΔP 0.04 iwg Stack Temp., Ts 891 °R Stack Area, As 49.35 ft^2

Sample Volume, Vm 392.4 ft^3 Stack Press., Psg -0.25 iwg Excess O_2, XO_2 % 8.4 %

Orifice Press. Diff., H 0.8 iwg ~~Stack Gas Sp. Gravity~~ ρ_{Flue}/ρ_{Air} @ T_s, Gs 1.042 n.d.

Sample Time, θ 300 min Nozzle Dia., Dn 3/4 in. Meter Temp., T_m 514 °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	397.16 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	42.19 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	0.096 N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	0.12008 grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	0.0000 1719 lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	0.2754 grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	400.68 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	871.77 ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	25194 WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	22775 DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	23.495 lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	167.2 N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	0.2955 lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	127.05 ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	93.5 %

	Oil	Gas	Coal	
Fe SC Feet/10^4 Btu	92.2	87.4	98.2	Coal + Bark 102.78
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636	0.002759

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated. Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS SASS

Test No. 13-24 Date 11-11-76 Location 13 WOODBARK Engr. SCOTT

Unit No. _____ Fuel _____ Sampling Train and Method _____

Pitot Factor, Fs .85 Barometric Pressure, P_{bar} 30.06 in. Hg

Tot. Liquid Collected, V_{lc} 710 ml Total Particulate, M_n ~3269 m gm

Velocity Head, ΔP .04 iwg Stack Temp., Ts 893 °R Stack Area, As 49.35 ft^2

Sample Volume, Vm 370.5 ft^3 Stack Press., Psg -.25 iwg Excess O_2, XO_2% 8.5 %

Orifice Press. Diff., H .8 iwg Stack Gas Sp. Gravity, Gs 1.04 n.d.

Sample Time, θ 300 min Nozzle Dia., Dn .75 in. Meter Temp., T_m 501 °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	394.5	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	33.65	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	0.078	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	0.1277	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	18.28×10^{-6}	lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	0.2928	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	408.6	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps}} \times \frac{1.00}{Gs}$	864.25	ft/min
7. Stack Gas Flow Rate @ 70°F	a. Qsw = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	25413	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	23415	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	25.68	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	168.1	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	0.316	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	135.8	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	90.28	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE CALCULATION SHEET

Test Crew _____

Test No. 13-7 Date 11-3-76 Location 13

Box No. 1 Sample Probe Position 20" IN.

Test Description

Dry Gas Meter Vol. (ft^3)

Final 1661.76

Initial 1601.76

Total 60.0

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final	166	122	1.5	757.0	
Initial	100	100	0	745.4	
Δ Vol	66	22	1.5	11.6	101.1

Beaker No. 3		1	2	4	5 (H_2O)	6	Filter No. 10	Blank No. 11
Date Weighed	11-2-76							
Tare	1 101.9817	100.0970	101.6226	99.2539	98.9209	100.4793	.8062	.8585
Wt.	2	100.0970	101.6225	99.2539	98.9204		.8062	.8585
	3							
	4							
	5							
	6							
Avg	101.9817	100.0970	101.6225	99.2539	98.9209	100.4793	.8062	.8585
Bottle No.								
Content		Impinger (Water)	Probe (Acetone)	Probe (Water)	Cyclone (Acetone)		Flask (Dry)		
Rinse (ml)	475	300	150	325	160			
Date Weighed or 250 Bake	11-5-76							
Final	1 102.2005	100.1207	101.6286	99.2700	98.9301	100.5215	1.1075	.8585
Wt. 250	2 102.2004	100.1207	101.6286	99.2700	98.9301	100.5216	1.1076	.8585
	3					100.5216		
	4							
	5							
	6							
Avg	102.2005	100.1207	101.6286	99.2700	98.9301	100.5216	1.1076	.8585
Residue wt Final 250-Tare	.2188	.0237	.0061	.0161	.0097	.0423	.3014	0
Date Weighed or 650 Bake								
Final	1							
Wt. 650	2							
	3							
	4							
	5							
	6							
Avg								
Residue Wt Final 650-Tare								

Comments:

H_2O BLANK #7 100 ml

104.0063

104.0066

104.0066

+ .0003

ACETONE BLANK #8 100 ml

99.3215

99.3200

99.3200

− .0015

Data Sheet 6002-3

PARTICULATE CALCULATION SHEET

Test No. 13-17 Date 11-9-76 Location 13 Test Crew

Box No. Sample Probe Position

Test Description 20 NO_x, PARTICULATE

Dry Gas Meter Vol. (ft^3)
Final 1739.450
Initial 1679.446
Total 60.004

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final	199	148	8	715.0	
Initial	100	100	0	698.7	
Δ Vol	99	48	8	16.3	171.3

Beaker No.	1	2	4	5 (cycl H_2O)	6 (cycl ACE)	7	Filter No. 11	Blank No. 12
Date Weighed	11-8-76							
Tare Wt. 1	100.0931	101.6243	99.2489	98.9189	100.4784	104.0029	.8575	.8011
2	100.0931	101.6243	99.2490	98.9189	100.4783	104.0030	.8575	.8011
3								
4								
5								
6								
Avg	100.0931	101.6243	99.2490	98.9189	100.4784	104.0030	.8575	.8011
Bottle No.								
Content	Impinger (Water)	Probe (Acetone)	Probe (Water)	Cyclone (Acetone)		Flask (Dry)		
Rinse (ml)	610	325	125	175	200			
Date Weighed or 250 Bake	11-10-76							
Final Wt. 250 1	100.2642	101.6543	99.2538	98.9278	100.5136	104.2100	1.2936	.8010
2	100.2642	101.6543	99.2538	98.9278	100.5136	104.2100	1.2936	.8010
3								
4								
5								
6								
Avg	100.2642	101.6543	99.2538	98.9278	100.5136	100.2100	1.2936	.8010
Residue wt Final 250-Tare	.1711	.0300	.0049	.0089	.0352	.2071	.4361	-.0001
Date Weighed or 650 Bake								
Final Wt. 650 1								
2								
3								
4								
5								
6								
Avg								
Residue Wt Final 650-Tare								

Comments:

H_2O BLANK = +.0003 g/100 ml

ACE BLANK = -.0015 g/100 ml

Data Sheet 6002-3

PLANT
LOCATION 13
OPERATOR R.P
DATE 11-3-76
RUN NO. 13-7
SAMPLE BOX NO.
METER BOX NO.
METER H
C FACTOR @

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 43
BAROMETRIC PRESSURE 29.79
ASSUMED MOISTURE, % 15
HEATER BOX SETTING
PROBE LENGTH, IN.
NOZZLE DIAMETER, IN. 1/2
PROBE HEATER SETTING

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time (~~military~~. CLOCK TIME	Static Pressure (P_s), In. Hg.	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
20"W	1115	-.25	410	.035	.69	1601.76		55	290	60
	1130		400	.035	.69	1611.26		40	230	35
	1145		405	.035	.69	1621.00		40	290	45
	1200		400	.035	.69	1630.00		40	295	45
	1215		395	.035	.69	1640.00		40	340	42
	1230		395	.035	.69	1649.00		40	320	42
	1247		40	.035	.69	1661.76		40	320	45
TOTAL								AVG.	AVG.	
AVERAGE								AVG.		

PLANT
LOCATION 13
OPERATOR
DATE 11-3-78
RUN NO. 13-8
SAMPLE BOX NO.
METER BOX NO.
METER H
C FACTOR @

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 34
BAROMETRIC PRESSURE 29.86
ASSUMED MOISTURE, % ~15
HEATER BOX SETTING
PROBE LENGTH, IN.
NOZZLE DIAMETER, ~~dia.~~ 4 mm.
PROBE HEATER SETTING

SCHEMATIC OF STACK CROSS SECTION

BRINK IMPACTOR

Traverse Point Number	Sampling Time (e)Min.	Static Pressure (P_s), In. Hg.	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
20°,N	1505	-.25	400	.035	.060	1661.76		40	NA	45
	1520	-.25	400	.035	.060	1670.00		40	NA	45
	1535	-.25	400	.035	.060	1679.31		40	NA	45
TOTAL										
AVERAGE								AVG.	AVG.	

PLANT
LOCATION 13
OPERATOR
DATE 11-8-76
RUN NO. 13-17
SAMPLE BOX NO.
METER BOX NO.
METER H
C FACTOR @

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 32
BAROMETRIC PRESSURE 29.80
ASSUMED MOISTURE, % 8%
HEATER BOX SETTING
PROBE LENGTH, IN.
NOZZLE DIAMETER, IN. 1/2
PROBE HEATER SETTING

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time ~~(e)Min.~~ CLOCK TIME	Static Pressure (P_s), In. ~~Hg~~ H_2O	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
20"IN	1507	-.25"	395	.04	.86	1688.9			293	40
	1522	-.25"	408	.04	.86	1701.			330	45"
	1537	-.25"	410	.04	.86	1710.			345"	48
	1552	-.25"	410	.04	.86	1720.			360	50
	1607	-.25"	408	.04	.86	1730.			370	49
	1622	-.25"	420	.04	.86	1739.450			275"	55"
	INITIAL	METER	READING		1679.446					
TOTAL								AVG.	AVG.	
AVERAGE								AVG		

717

PLANT
LOCATION 13
OPERATOR PIONESSA, HAERTY, BOENING
DATE 11-9-76
RUN NO. 13-18
SAMPLE BOX NO.
METER BOX NO.
METER H
C FACTOR @

SASS ~~METHOD 5~~ CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 29.48
ASSUMED MOISTURE, %
HEATER BOX SETTING
PROBE LENGTH, IN.
NOZZLE DIAMETER, IN. 3/4
PROBE HEATER SETTING

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time ~~(elapsed)~~ CLOCK TIME	Static Pressure (P_s), In. Hg.	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprtature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
20"W	1115		434	.04	.8	611.300	46	44	379	43
	1145		433	.04	.8	651.200	53	47	403	52
	1215		437	.04	.8	691.200	54	50	405	53
	1245		433	.04	.8	727.800	55	51	405	54
	1315		431	.04	.8	767.800	57	54	406	54
	1350		434	.04	.8	811.000	58	54	405	53
	1415		435	.04	.8	844.300	57	55	407	55
	1420		CHANGED DESSICANT			844.300				
	1450		425	.04	.8	886.100	58	56	407	60
	1520		417	.04	.8	923.300	56	54	406	60
	1550		429	.04	.8	962.300	56	54	404	59
	1620		431	.04	.8	001.700	57	54	405	58
TOTAL								AVG.	AVG.	
NUMBER										

PLANT
LOCATION 13
OPERATOR
DATE 11-10-76
RUN NO. 13-20
SAMPLE BOX NO.
METER BOX NO.
METER H
C FACTOR

METHOD 5 CONTROL CONSOLE READINGS

SCHEMATIC OF STACK CROSS SECTION

AMBIENT TEMPERATURE 87
BAROMETRIC PRESSURE
ASSUMED MOISTURE, %
HEATER BOX SETTING
PROBE LENGTH, IN.
NOZZLE DIAMETER, IN. 4 mm
PROBE HEATER SETTING

BRINKS IMPACTOR

Traverse Point Number	Sampling Time ~~(elapsed)~~ min. clock time	Static Pressure (P_s), In. ~~Hg~~ H_2O	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
	1042	-.25	400	.04	.06	1739.51	NA	37	NA	45
	1057		410	.04	0	1741.16		37		45
	1112		420	.04	0	1791.76		37		35
	1127		420	.04	0	1743.32		37		32
	1157		420	.04	0	1746.10		37		33
	1227		420	.04	0	1748.81		37		33
	1242		420	.04	0	1749.99		37		33
TOTAL								AVG.	AVG.	

PLANT
LOCATION 13
OPERATOR PIONESSA, HAGERTY, BENNING
DATE 11-11-76
RUN NO. 13-24
SAMPLE BOX NO.
METER BOX NO.
METER H
C FACTOR @

GAS ~~METERING~~ CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 30.06
ASSUMED MOISTURE, %
HEATER BOX SETTING
PROBE LENGTH, IN.
NOZZLE DIAMETER, IN. 3/4
PROBE HEATER SETTING

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time ~~(minutes)~~ Clock Time	Static Pressure (P_s), In. Hg.	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
20"IN	0945		425	.04	.8	2.069	29	28	349	26
	1015		431	.04	.8	41.000	43	33	404	48
	1045		434	.04	.8	79.000	44	37	402	48
	1115		438	.04	.8	118.700	45	40	406	51
	1145		430	.04	.8	157.400	45	40	403	49
	1245		434	.04	.8	234.000	46	42	404	48
	1215		434	.04	.8	271.600	44	41	406	47
	1345		434	.04	.8	312.600	46	42	401	47
	1415		435	.04	.8	351.500	47	43	403	47
	1445		434	.04	.8	391.200	46	43	405	46
TOTAL										
AVERAGE			433					AVG.	AVG.	
								AVG.		

720

Test No. 13-8

CASCADE IMPACTOR DATA SHEET

TEST RUN NO. 13-8 LOCATION 13 DATE 11-3-76

IMPACTOR NO. 1 CYCLONE NO. — OPERATOR RON + HANS

SAMPLE POINT LOCATION STACK 20" IN

SUBSTRATE COATING NONE FUEL COAL + BARK TEST LOAD 70 klb/hr

IMPACTOR ORIENTATION HORIZ. FLOW THRU IMPACTOR .065 calcm. CFM

FLUE STATIC PRESSURE -.25 inH_2O, VELOCITY 13.2 ft/sec

NOZZLE DIA. 4 mm IMPACTOR PRESSURE DROP _____ END TIME 1535

GAS METER END 1679.31 CF START TIME 1505

GAS METER START 1661.76 CF DURATION 30

GAS VOLUME 17.55 CF ACTUAL FLOW RATE .585 * CFM

AMBIENT TEMPERATURE 34 °F PRESSURE 29.86 IN Hg. HUMIDITY 80 %

FLUE GAS MOLECULAR WT. 1 EST., TEMP. 400 °F, DENSITY _____ g/cc, VISCOSITY _____ POISE

* LOWEST ADJUSTABLE FLOW ON 20% BOX

	Stage Number							Stage Blank
	1	2	3	4	5			
Foil + Sample, g	3.6592	3.2455	3.6501	3.2330	3.7530			N/A
Unused Foil, g	3.6570	3.2429	3.6462	3.2309	3.7512			N/A
Sample, g	.0022	.0026	.0039	.0021	.0018			
Correction for Blank, g	—	—	—	—	—			
Final Sample, g	.0022	.0026	.0039	.0021	.0018			

FILTER NO.	Sample	Blank
FILTER + SAMPLE, g	.7737	NA
FILTER TARE, g	.7723	NA
SAMPLE, g	.0014	
CORRECTION FOR BLANK, g	NA	
FINAL SAMPLE, g	.0014	

FULL CONTAINER, g .4258 CATCH + PAPER

EMPTY CONTAINER, g .4228 PAPER

CYCLONE CATCH, g .0030

Test No. 13-20

CASCADE IMPACTOR DATA SHEET

TEST RUN NO. 13-20 LOCATION 13 DATE 11-9-76

IMPACTOR NO. 1 CYCLONE NO. 1 OPERATOR R. PIONEER St.

SAMPLE POINT LOCATION STACK 20" I.D.

SUBSTRATE COATING N/A FUEL COAL + BARK TEST LOAD 80 klb/hr

IMPACTOR ORIENTATION HORIZ FLOW THRU IMPACTOR _____ CFM

FLUE STATIC PRESSURE -.25 inH_2O, VELOCITY 14.28 ft/sec (Δp = .04)

NOZZLE DIA. 4 mm IMPACTOR PRESSURE DROP _____ END TIME 1242

GAS METER END 1749.99 CF START TIME 1042

GAS METER START 1739.51 CF DURATION 120 MIN

GAS VOLUME 10.48 CF FLOW RATE .087 CFM

AMBIENT TEMPERATURE 33 °F PRESSURE 29.84 IN Hg. HUMIDITY _____ %

FLUE GAS MOLECULAR WT. _____, TEMP. 420 °F, DENSITY _____ g/cc, VISCOSITY _____ POISE

	Stage Number							Stage Blank
	1	2	3	4	5			
Foil + Sample, g	3.6742	3.2535	3.6555	3.2369	3.7542			NA
Unused Foil, g	3.6553	3.2417	3.6447	3.2313	3.7510			
Sample, g	.0189	.0118	.0108	.0056	.0032			
Correction for Blank, g	NA	→	→	→	→	→	→	
Final Sample, g								

FILTER NO.	Sample	Blank
FILTER + SAMPLE, g	.8164	
FILTER TARE, g	.8122	
SAMPLE, g	.0042	
CORRECTION FOR BLANK, g	NA	
FINAL SAMPLE, g		

FULL CONTAINER, g .4175

EMPTY CONTAINER, g .4145

CYCLONE CATCH, g .0030

LOCATION 13 - WOODBARK BOILER
TEST NO. 13-8

TABLE 1.

	Symbol	Value
Pressure drop across impactor during test "Hg"	ΔP_2	0.22
Static pressure at inlet to impactor, atm. P = -.25" NC	P_2	.999
Density of aerosol particle, grams/cc	P_p	1.0
Density of gas at inlet sampling conditions, grams/cc	P_2	7.1×10^{-4}
Molecular weight of sample gas	MW_2	30.16
Molecular weight of calibration gas	MW_1	28.95
Temperature of gas at sampling conditions, °K	T_2	477
Temperature of gas at calibration conditions, °K	T_1	294
Static pressure under calibration conditions, atm.	P_1	1
Gas viscosity at sampling conditions, poises	μ	3.4×10^{-4}
Stage jet diameter, cm	D_{c_2}	.249
	D_{c_3}	.1775
	D_{c_4}	.1396
	D_{c_5}	.0946
	D_{c_6}	.0731
Sample quantity collected on each cup	R_2	.0022
	R_3	.0026
	R_4	.0039
	R_5	.0021
	R_6	.0018
FILTER	R_7	.0014
Dimension conversion constant	g_c	1

TABLE 2.

	Symbol	Value
Effective pressure drop, "Hg"	ΔP_E	0.34
Inlet flow to impactor, cc/second	F	25.01
Pressure out of stages, atm.	P_{S_2}	.999
	P_{S_3}	.999
	P_{S_4}	.999
	P_{S_5}	.997
	P_{S_6}	.992
Density of gas out of the various stages, grams/cc	P_{S_2}	7.1×10^{-4}
	P_{S_3}	7.1×10^{-4}
	P_{S_4}	7.1×10^{-4}
	P_{S_5}	7.08×10^{-4}
	P_{S_6}	7.04×10^{-4}
Characteristic diameter, microns	D_{pc_2}	6.37
	D_{pc_3}	3.76
	D_{pc_4}	2.56
	D_{pc_5}	1.35
	D_{pc_6}	0.86
Criteria for validity of equation 18	$\frac{D_{pc_6} \times 10^{-4}}{L}$	5.37
Mean free path	L	1.602×10^{-5}
Average molecular velocity	$\bar{v}$	6.029×10^{4}

Continued

TABLE 2 (Continued)

	Symbol	Value	%
% on a cup of the total sample collected	CYCLONE	.0030	.1765
Stage 2	γ_2	.0022	.1294
3	γ_3	.0026	.1529
4	γ_4	.0039	.2294
5	γ_5	.0021	.1235
6	γ_6	.0018	.1059
Filter	γ_7	.0014	.0823
	Total	.0170	100.00*

*Any discrepancy due to rounding off should be buried in the largest γ cumulative % smaller than D_{pc}

Σ_2	69.4
Σ_3	54.1
Σ_4	31.1
Σ_5	18.8
Σ_6	8.2

LOCATION 13 WOOD BARK BOILER
TEST NO. 13-20

TABLE 1.

	Symbol	Value
Pressure drop across impactor during test "Hg"	ΔP_2	0.37
Static pressure at inlet to impactor, atm.	P_2	.999
Density of aerosol particle, grams/cc	P_p	1.0
Density of gas at inlet sampling conditions, grams/cc	P_2	7.1×10^{-4}
Molecular weight of sample gas	MW_2	30.16
Molecular weight of calibration gas	MW_1	28.95
Temperature of gas at sampling conditions, °K	T_2	486
Temperature of gas at calibration conditions, °K	T_1	294
Static pressure under calibration conditions, atm.	P_1	1
Gas viscosity at sampling conditions, poises	μ	3.4×10^{-4}
Stage jet diameter, cm	D_{c_2}	.249
	D_{c_3}	.1775
	D_{c_4}	.1396
	D_{c_5}	.0946
	D_{c_6}	.0731
Sample quantity collected on each cup	R_2	.0189
	R_3	.0118
	R_4	.0108
	R_5	.0056
	R_6	.0032
	R_7	.0042
Dimension conversion constant	g_c	1

TABLE 2.

	Symbol	Value
Effective pressure drop, "Hg"	ΔP_E	0.587
Inlet flow to impactor, cc/second	F	19.5
Pressure out of stages, atm.	P_{S_2}	.999
	P_{S_3}	.999
	P_{S_4}	.999
	P_{S_5}	.996
	P_{S_6}	.987
Density of gas out of the various stages, grams/cc	P_{S_2}	0.00071
	P_{S_3}	0.00071
	P_{S_4}	0.00071
	P_{S_5}	7.09×10^{-4}
	P_{S_6}	7.02×10^{-4}
Characteristic diameter, microns	D_{pc_2}	7.24
	D_{pc_3}	4.28
	D_{pc_4}	2.93
	D_{pc_5}	1.55
	D_{pc_6}	.993
Criteria for validity of equation 18	$\frac{D_{pc_6} \times 10^{-4}}{L}$	6.24
Mean free path	L	1.59×10^{-5}
Average molecular velocity	$\bar{v}$	6.02×10^{4}

Continued

TABLE 2 (Continued)

	Symbol	Value	%
% on a cup of the total sample collected	cyclone	.0030	.0521
Stage 2	γ_2	.0189	.3287
3	γ_3	.0118	.2052
4	γ_4	.0108	.1878
5	γ_5	.0056	.0974
6	γ_6	.0032	.0556
Filter	γ_7	.0042	.0730
	Total →	.0575 100.00*	1.0000

*Any discrepancy due to rounding off should be buried in the largest γ cumulative % smaller than D_{pc}

	94.8
Σ_2	61.9
Σ_3	41.4
Σ_4	22.6
Σ_5	12.9
Σ_6	7.3

PLUME OPACITY OBSERVATION RECORD

Test Run No. 13-7

LOCATION NO. 13 OBSERVER H. BUENING

OWNER _____ BOILER NO. 5 CAPACITY 100 klb/hr

DATE 11-3-76 FUEL TYPE COAL + BARK BURNER TYPE DETROIT STOKER

POINT OF EMISSION STACK

POINT OF OBSERVATION 100 YARDS NORTH OF STACK

TEST No.	TEST Time am/pm	TEST Type	Test Load k#/hr	Opacity %	WIND Speed mph	WIND Direct.	Sky Cond.	Sun Position	Comments
	1130	PARTIC	90	25	~20	WESTERLY GUSTY	CLOUDY	NOT VISIBLE	
	1133			40					GREY CLOUDY SKY VERY DIFFICULT TO READ CORRECT OPACITY READINGS MIGHT BE LOW!
	1136			35					
	1139			35					
	1142			30					
	1145			30					
	1148			35					
	1151			35					
	1154			30					
	1157			30					
	1200			35					
	1203			45					
	1206			30					
	1209			35					
	1212			35					
	1215			35					

PLUME OPACITY OBSERVATION RECORD

Test Run No. 13-17

LOCATION NO. 13 OBSERVER HANS BUENING

OWNER _____ BOILER NO. 5 CAPACITY 100 klb/hr

DATE 11-8-76 FUEL TYPE COAL + BARK BURNER TYPE DETROIT STOKER

POINT OF EMISSION STACK

POINT OF OBSERVATION 100 YARDS NORTH OF STACK

TEST No.	TEST Time am/pm	TEST Type	Test Load k#/hr	Opacity %	WIND Speed mph	WIND Direct.	Sky Cond.	Sun Position	Comments
	1500	PARTIC	~90	40	~10	FROM N.W.	CLOUDY	NOT VISABLE	
	1503			40					
	1506			45					
	1509			40					
	1512			40					
	1515			45					
	1518			45					
	1521			50					
	1524			45					VERY CLOUDY GRAY SKY
	1527			45					
	1530			45					
	1533			40					
	1536			40					
	1539			45					
	1542			45					
	1545			45					

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 11-3-76

Location: 13

Unit: 5

Test: 18-7 Personnel: _____

Fuel: COAL + BARK

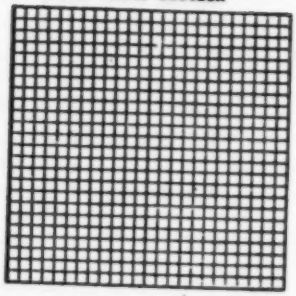
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. H_2O Gage): -.25 (P_g)

Pitot Tube Coefficient: .84 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
		6"	.08	390				
		12	.06					
		18	.04					
		24	.02					
		30	.01					
		36	.02					
		42	.02					
		48	.03					

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Data: 11-8-76 _____

Location: 13 _____

Unit: 5 _____

Test: 13-17 _____ Personnel: _____

Fuel: COAL + BARK _____

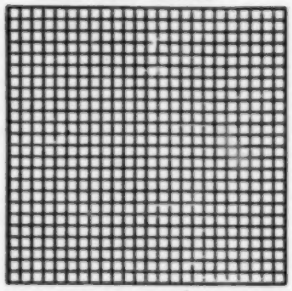
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. H_2O): -.25 (P_g)

Pitot Tube Coefficient: .84 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
		6"	0.10	400	860			
		12"	0.08					
		18"	0.04					
		20"	.045					
		24"	0.025					
		30"	0.02					
		36"	0.01					
		42"	0.01					

6002-13

Date 11-2-76

KVB, INC.

Test No. 13/1

SOx DATA SHEET

TEST NO. 13/1 UNIT NO. 5 FUEL COAL + BARK LOAD 90 klb/hr Location 13

Box No.	1	1			
Time	1239	1251			
Temp. in Gas Meter	54	54			
Press. in Gas Meter	0	0			
Meter Reading	0	1.000			
Barom. Press.	29.87	29.87			
Percent Oxygen	8.5	7.0			
N_2 Purge Time	1258	—			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V\,(P + p)}$

Excess O_2 7.75 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	15.5	11.8	
B = Ml of lead perchlorate used for bland =	6.1	6.1	
N = Normality of lead perchlorate titrant =	.0095	.0095	
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	514	514	
V = Volume of gas sample ft^3 =	1.000	1.000	
P = Barometric pressure =	29.87	29.87	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	732	28	
, ng/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 11-2-76

KVB, INC.

Test No. 13/1

SOx DATA SHEET

TEST NO. 13/1 UNIT NO. 5 FUEL COAL + BARK LOAD 80 klb/hr Location 13

Box No.	2	2			
Time	1339	1353			
Temp. in Gas Meter	54	54			
Press. in Gas Meter	0	0			
Meter Reading	0	1.000			
Barom. Press.	29.86	29.86			
Percent Oxygen	7.8	7.5			
N_2 Purge Time	1400	1425			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V\,(P + p)}$

Excess O_2 7.5 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	17.0	11.8	
B = Ml of lead perchlorate used for bland =	6.1	6.1	
N = Normality of lead perchlorate titrant =	.0095	.0095	
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	514	514	
V = Volume of gas sample ft^3 =	1.000	1.000	
P = Barometric pressure =	29.86	29.86	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	153	22	
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

TABLE TRACE SPECIES AND ORGANICS SAMPLING CONDITIONS
LOCATION 13 - WOOD/BARK BOILER

TS&O Run No.	1	2
Test No.	13-18	13-24
Date	11-9-76	11-11-76
Port Location	Dust Coll. Outlet	Dust Coll. Outlet
Stack Velocity, m/s (f/s)	4.42 (14.5)	4.39 (14.4)
Stack Temp., K (°F)	495 (431)	496 (433)
Oxygen Content, % dry	8.4	8.5
Moisture, %	9.6	7.8
Sample Time, min.	300	300
Cyclone Flow, awm^3/m (awcfm)	0.065 (2.31)	0.065 (2.31)
Isokinetic Rate, %	93.5	80.3
Oven Temperature, K (°F)	429 (403)	477 (398)
XAD-2 Temp., K (°F)	291 (64)	292 (65)
Meter Temp., K (°F)	285 (54)	278 (41)
Nozzle Size, mm (in.)	19 (3/4)	19 (3/4)
No. Filters Used	1	1
Sample Flow, dry, $\underline{DNm}^3/m$ (scfm)	0.372 (1.31)	0.0371 (1.31)
Volume Collected, dry, $\underline{DNm}^3$(scf)	11.25 (397.2)	11.17 (394.3)
Particulate Weight, g	3.0969	3.2690
Solid Particulates, ng/J (lb/MMBtu)	127 (0.296)	136 (0.316)

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 13-18 Date 11-9/76 Location 13 Wood-Bark Boiler

Sample Port Position Downstream Of Precipitator - Coal & Wood Fuel

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment	
	392	S P+N+10μ Solid	4oz NAL	0.2803g	24.3279 DoAA After SGMS	
	737	S 3μ Solid	"	0.2647g	23.4303 DoAA After SGMS	
	740	S 1μ Solid	"	1.1314g	24.7615	
	282	S #1 Filter	Petri	1.2379g	145.3491	
M *	605	L P+N+10μ Wash	16 oz A	409ml	1334	Dup. GC.
	606	L 3μ Wash	"	459ml		
	607	L 1μ Wash	"	332ml		
	333	L Filt. Hous. Wash	8oz A	134ml		
N*	264	L XAD Mod Rinse	"	145ml	349	
	331	L "	"	204ml		
	530	S XAD Resin	16 Oz AWM	139g	417.5-279	
∅ *	346	L XAD Condensate	8oz A	156ml	820	No PCB
	528 ∅1	L / "	1L NAL	714ml		
	516	L dMP #1	"	954ml	840 - 114	431 Rinse
	517	L 1MP #2	"	912ml	740 = 172	
	518	L 1MP #3	"	905ml	760 - 145	
	559	SB XAD Blank KVB	4oz NAL	9.1386g	326785 Tot	No PCB
	420	SB XAD Blank ARU	"	21.9876g	46.0874 Tot	
	339	LB 1MP 2&3 Blank	8oz A	130ml		
	340	LB H2O Blank	"	150ml		
X	341	LB 50/50 Rinse Blank	"	144ml		
X	342	LB IPA Rinse Blank	"	138ml		
X	338	LB	"	140ml		
	283	SB Filter Blank	Petri	0.0034	147.3176 Tot	
	1038	SF Coal Fuel	16Oz AWM			
	1032	SF Wood Fuel	Can			
	1033	SF Boiler Ash	Can		Dup	
	1034	SF ESP Ash	Can		Dup	

Count S - 5, SB - 3, SF - 2 = 12 Solid + 2 Dups; L - 3, LB - 2 = 5 Liquids + 1 Dup

Data Sheet KVB 6002-15
SD - 2AA, 1GC
LD = 1AA + 1GC
28 Bottles
17 Analyses.

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 13-18 Date 11/9/76 Location 13 Wood-Bark Boiler

Sample Port Position Downstream Of Precip - Coal & Wood Fuel

SSNS For 13-18

	Container Number		Sample Description	Container Type	Net wt/vol.	Comment
13-18 A	392	S	P+N+10μ Solids	100%	0.2803g	Do SSNS Then AA
13-18 B	737	S	3μ Solids	100%	0.2647g	"
13-18 C	740	S	1μ Solids	48%	1.1314g	
		S	#1 Filter	52%	1.2379g	
13-18 D	530	S	XAD Resin	100%	139g	
13-18 E	264 N	L	XAD Mod Rinse	8oz A	145	349ml 9%
	331	L	"	"	204	
	346	L	XAD Condensate	"	156	870ml 22% DUP
	328 Ø	L	"	1 L N	714	
	Ø 516	L	Imp #1	"	954	24%
	517	L	Imp #2	"	912	23%
	518	L	Imp #3	"	905	22%
					3990	
13-18 F	559	SB	XAD - KVB Blank	4oz N	3.1385g	100%
13-18 G	420	SB	XAD - ARL Blank	4oz N	21.9876g	100%
13-18 H	339	LB	Imp 2+3 Blank	8oz A	130ml	100%
13-18 I	1038	SF	Coal	16oz AWM		100%
13-18 J	1032	SF	Wood	Can		100%
13-18 K	1033	SP	Boiler Ash	"		100%
13-18 L	1034	SP	ESP Ash	"		100%
		SSNS Count				
		S- 4		L-1		
		SB- 2		LB-1		
		SF- 2		2 Liquids		
		SP- 2		12 Analyses		
		10 Solids				

Data Sheet KVB 6002-15

Test 13-18 TABLE Downstream of Precip.-coal & wood fuel

POLLUTANT	SAMPLE NUMBER							
	392+	737+	740+	282+	M*	N*	530+	β*
Antimony	—	—	—	—	<0.5	<0.5	<50	0.6
Arsenic	—	—	1700	1600	0.040	+0.010	<3	<0.010
Barium	—	—	—	—	<0.05	<0.05	2.5	<0.05
Beryllium	—	—	—	—	<0.005	<0.005	<0.5	<0.005
Cadmium	—	—	—	—	<0.01	<0.01	<0.5	0.01
Calcium	—	—	—	—	200	0.33	150	0.37
Chromium	—	—	—	—	0.05	1.10	2.5	0.60
Cobalt	—	—	—	—	<0.05	<0.05	<25	<0.05
Copper	—	—	—	—	0.06	0.02	1.5	0.10
Iron	—	—	—	—	6.9	11.0	21.0	4.3
Lead	—	—	—	—	0.21	<0.03	<5	<0.03
Manganese	—	—	—	—	1.6	0.57	1.5	0.15
Mercury	0.6	0.5	0.4	0.4	<0.005	<0.005	<0.5	<0.005
Nickel	—	—	—	—	0.15	2.2	<1	0.53
Selenium	—	—	—	—	<0.01	<0.01	<5	<0.01
Tellurium	—	—	—	—	<5	<5	<25	<5
Tin	—	—	—	—	<1	<1	<250	<1
Titanium	—	—	—	—	<1	<1	15	<1
Vanadium	—	—	—	—	<0.1	<0.1	<5	<0.1
Zinc	—	—	—	—	0.60	0.088	1.0	0.11
Chloride	—	—	130	—	2.12	14.9	10.6	23.4
Fluoride					<0.20	4.10		6.30
Nitrates	—	—	<5	—	0.86	0.44	5.2	<0.10
Sulfates	—	—	80,000	—	55.0	32.0	520	23400
					605, 606, 607, 333	264, 331		346, 528, 516, 517, 518

13- Wood Bark Boiler

Test 13-18 TABLE Downstream of Precip.-coal & wood fuel

POLLUTANT	SAMPLE NUMBER							
	β* dupl.	β_1*	559+	420+	339*	340*	283+	1038+
Antimony	0.6		<50	<50	0.8	<0.5	—	<50
Arsenic	<0.010		<3	<3	<0.010	<0.010	—	<3
Barium	<0.05		<2.5	<2.5	<0.05	<0.05	—	5
Beryllium	<0.005		<0.5	<0.5	<0.005	<0.005	—	2
Cadmium	0.01		<0.5	<0.5	0.02	<0.01	—	<0.5
Calcium	0.36		8000	1900	0.43	0.63	—	140
Chromium	0.60		<0.5	<1	<0.05	<0.05	—	10
Cobalt	<0.05		<25	<25	<0.05	<0.05	—	<25
Copper	0.10		<0.5	6	<0.01	<0.01	—	5.5
Iron	4.3		77	41	0.26	<0.05	—	6200
Lead	<0.03	no metals	10	5	<0.03	<0.03	—	10
Manganese	0.14		8	4	0.01	<0.01	—	14.0
Mercury	<0.005		<0.5	<0.5	<0.005	<0.005	0.1/paper	<0.5
Nickel	0.53		1.5	1.5	0.05	<0.05	—	5.0
Selenium	<0.01		<5	<5	<0.01	<0.01	—	<5
Tellurium	<5		<25	<25	<5	<5	—	<25
Tin	<1		<250	<250	<1	<1	—	<250
Titanium	<1		40.0	<25	<1	<1	—	700
Vanadium	<0.1		<5	<5	<0.1	<0.1	—	15.0
Zinc	0.11		6.5	4.0	0.026	<0.005	—	12
Chloride	20.8	—	<13	<13	58.6	<0.6	(<800)	<13
Fluoride	6.75	—			3.23	1.63		
Nitrates	<0.10	0.46	5.0	<5	<0.10	0.48	<5	11.0
Sulfates	24600	13400	<250	250	35200	<5	<800	1800

346, 528, 516

13- Wood Bark Boiler

Test 13-18 TABLE Downstream of Precip.-coal & wood fuel

POLLUTANT	SAMPLE NUMBER							
	1032+	1033+	1033+ dup	1034+	1034+ dup			
Antimony	<50	<50	<50	<50	<50			
Arsenic	<3	<3	<3	50	70			
Barium	5	200	130	280	320			
Beryllium	<0.5	3.5	5.0	5.0	6.0			
Cadmium	0.5	4.5	4.5	4.5	4.0			
Calcium	5000	200	350	37000	33000			
Chromium	3.5	87	84	72	69			
Cobalt	<25	<25	<25	<25	<25			
Copper	3	38	42	64	64			
Iron	650	32000	37000	44000	46000			
Lead	<5	15	20	45	140			
Manganese	125	85	85	500	900			
Mercury	<0.5	<0.5	<0.5	<0.5	<0.5			
Nickel	<1	50	50	50	45			
Selenium	<5	<5	<5	6	7			
Tellurium	<25	<25	<25	<25	<25			
Tin	<250	<250	<250	<250	<250			
Titanium	240	14000	14000	6000	4500			
Vanadium	5	130	140	120	120			
Zinc	18	18	19	180	190			
Chloride	405	<13	<13	270	240			
Fluoride								
Nitrates	15.3	<5	<5	<5	<5			
Sulfates	132	500	850	26000	25000			

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 838 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 738-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 13 - 18 A 392 PN 10 >0.1

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.8	Terbium		Ruthenium		Vanadium	34
Thorium	≤1	Gadolinium		Molybdenum	100	Titanium	110
Bismuth	9	Europium		Niobium	5	Scandium	≤0.1
Lead	MC	Samarium		Zirconium	3	Calcium	MC
Thallium	≤0.3	Neodymium	0.3	Yttrium	0.3	Potassium	MC
Mercury	NR	Praseodymium	0.1	Strontium	5	Chlorine	MC
Gold		Cerium	0.7	Rubidium	10	Sulfur	MC
Platinum		Lanthanum	0.5	Bromine	78	Phosphorus	MC
Iridium		Barium	27	Selenium	34	Silicon	MC
Osmium		Cesium	0.7	Arsenic	240	Aluminum	MC
Rhenium		Iodine	5	Germanium	56	Magnesium	MC
Tungsten	6	Tellurium	330	Gallium	37	Sodium	MC
Tantalum		Antimony	88	Zinc	MC	Fluorine	≈400
Hafnium		Tin	260	Copper	MC	Oxygen	NR
Lutetium		Indium	STD	Nickel	93	Nitrogen	NR
Ytterbium		Cadmium	180	Cobalt	19	Carbon	NR
Thulium		Silver	47	Iron	MC	Boron	11
Erbium		Palladium		Manganese	MC	Beryllium	<0.1
Holmium		Rhodium		Chromium	860	Lithium	2
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.1 ppm weight

Approved: M Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 999 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484

Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 13 - 18 B 737 3μ sol

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	15	Terbium	0.9	Ruthenium		Vanadium	530
Thorium	11	Gadolinium	3	Molybdenum	95	Titanium	MC
Bismuth	2	Europium	1	Niobium	24	Scandium	41
Lead	190	Samarium	9	Zirconium	230	Calcium	MC
Thallium	23	Neodymium	24	Yttrium	70	Potassium	MC
Mercury	NR	Praseodymium	11	Strontium	MC	Chlorine	400
Gold		Cerium	62	Rubidium	610	Sulfur	MC
Platinum		Lanthanum	37	Bromine	41	Phosphorus	MC
Iridium		Barium	MC	Selenium	58	Silicon	MC
Osmium		Cesium	7	Arsenic	MC	Aluminum	MC
Rhenium	≤0.1	Iodine	10	Germanium	MC	Magnesium	MC
Tungsten	6	Tellurium	≤0.5	Gallium	780	Sodium	MC
Tantalum	≤0.7	Antimony	21	Zinc	MC	Fluorine	=MC
Hafnium	1	Tin	19	Copper	960	Oxygen	NR
Lutetium	0.5	Indium	STD	Nickel	290	Nitrogen	NR
Ytterbium	2	Cadmium	3	Cobalt	32	Carbon	NR
Thulium	0.3	Silver	11	Iron	MC	Boron	MC
Erbium	1	Palladium	2	Manganese	MC	Beryllium	1
Holmium	3	Rhodium		Chromium	810	Lithium	37
Dysprosium	4					Hydrogen	NR

NR – Not Reported
All elements not reported <0.1 ppm weight

Approved: M. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

Reply to GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 [illegible]
INSTRUMENTAL ANALYSIS DIVISION, 14233 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-[illegible]

To: Mr. John G. Michalovic
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Post Office Box 235
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Analyst: S. Sweeney

P. O. No.: 27810
Sample No.: 13 - 18 C 740, 282 In filt

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	13	Terbium	1	Ruthenium		Vanadium	MC
Thorium	16	Gadolinium	3	Molybdenum	130	Titanium	MC
Bismuth	9	Europium	2	Niobium	46	Scandium	16
Lead	MC	Samarium	10	Zirconium	290	Calcium	MC
Thallium	48	Neodymium	17	Yttrium	37	Potassium	MC
Mercury	NR	Praseodymium	6	Strontium	MC	Chlorine	250
Gold		Cerium	130	Rubidium	MC	Sulfur	MC
Platinum	≤0.3	Lanthanum	52	Bromine	43	Phosphorus	MC
Iridium		Barium	MC	Selenium	61	Silicon	MC
Osmium	≤0.2	Cesium	22	Arsenic	940	Aluminum	MC
Rhenium	≤0.1	Iodine	12	Germanium	MC	Magnesium	MC
Tungsten	11	Tellurium	2	Gallium	MC	Sodium	MC
Tantalum	≤0.6	Antimony	120	Zinc	MC	Fluorine	MC
Hafnium	2	Tin	100	Copper	MC	Oxygen	NR
Lutetium	0.2	Indium	STD	Nickel	470	Nitrogen	NR
Ytterbium	2	Cadmium	18	Cobalt	29	Carbon	NR
Thulium	0.4	Silver	10	Iron	MC	Boron	710
Erbium	2	Palladium	4	Manganese	MC	Beryllium	2
Holmium	2	Rhodium	≤0.2	Chromium	MC	Lithium	40
Dysprosium	4					Hydrogen	NR

NR – Not Reported
All elements not reported <0.1 ppm weight

Approved: M. Stacchs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 738-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9321

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 13-18 D 530 Y A9

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	<0.1
Thorium		Gadolinium		Molybdenum	3	Titanium	1
Bismuth		Europium		Niobium		Scandium	≤0.1
Lead	≤0.9	Samarium		Zirconium	2	Calcium	45
Thallium		Neodymium		Yttrium	0.2	Potassium	37
Mercury	NR	Praseodymium		Strontium	4	Chlorine	2
Gold		Cerium		Rubidium	<0.1	Sulfur	6
Platinum		Lanthanum		Bromine	0.7	Phosphorus	16
Iridium		Barium	0.8	Selenium		Silicon	36
Osmium		Cesium		Arsenic	0.2	Aluminum	5
Rhenium		Iodine	≤0.2	Germanium		Magnesium	10
Tungsten		Tellurium		Gallium	≤0.2	Sodium	61
Tantalum		Antimony		Zinc	3	Fluorine	≈2
Hafnium		Tin		Copper	3	Oxygen	NR
Lutetium		Indium	STD	Nickel	3	Nitrogen	NR
Ytterbium		Cadmium	≤0.4	Cobalt	<0.1	Carbon	NR
Thulium		Silver	0.7	Iron	9	Boron	2
Erbium		Palladium		Manganese	0.4	Beryllium	
Holmium		Rhodium		Chromium	6	Lithium	0.1
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.2 ppm weight

Approved: M. Stacks

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 230 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14333 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Liquids

Sample No.: 13-18 E #1 264, 331, 346, 528, 516, 517, 518

IAD No.: 97-A197-134-31

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.05	Titanium	0.05
Bismuth	≤0.008	Europium		Niobium		Scandium	≤0.003
Lead	0.03	Samarium		Zirconium	0.01	Calcium	3
Thallium		Neodymium		Yttrium		Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.02	Chlorine	0.3
Gold		Cerium	0.005	Rubidium	0.002	Sulfur	MC
Platinum		Lanthanum	0.01	Bromine	0.009	Phosphorus	0.8
Iridium		Barium	0.05	Selenium	≤0.01	Silicon	0.3
Osmium		Cesium	≤0.002	Arsenic	≤0.002	Aluminum	0.6
Rhenium		Iodine		Germanium		Magnesium	0.5
Tungsten		Tellurium		Gallium	≤0.004	Sodium	MC
Tantalum		Antimony		Zinc	0.08	Fluorine	≈0.04
Hafnium		Tin		Copper	0.2	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.6	Nitrogen	NR
Ytterbium		Cadmium	≤0.007	Cobalt	0.02	Carbon	NR
Thulium		Silver	MC	Iron	2	Boron	0.2
Erbium		Palladium		Manganese	0.06	Beryllium	
Holmium		Rhodium		Chromium	1	Lithium	0.009
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported < 0.004 µg/ml

Approved: M Yacobs

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucible prior to analysis.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 738-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14333 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9221

To: Mr. John Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810 Dup

Sample No.: 13 -18 E #2 264, 331, 346, 528, 516, 517, 518 IAD No.: 97-A197-134-31

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.008
Thorium		Gadolinium		Molybdenum	0.1	Titanium	0.02
Bismuth	≤0.008	Europium		Niobium		Scandium	≤0.001
Lead	0.03	Samarium		Zirconium	0.02	Calcium	2
Thallium		Neodymium		Yttrium		Potassium	4
Mercury	NR	Praseodymium		Strontium	0.009	Chlorine	0.2
Gold		Cerium	0.005	Rubidium	0.003	Sulfur	MC
Platinum		Lanthanum	0.01	Bromine	0.009	Phosphorus	0.5
Iridium		Barium	0.1	Selenium	≤0.02	Silicon	0.7
Osmium		Cesium	≤0.003	Arsenic	≤0.004	Aluminum	0.2
Rhenium		Iodine	0.009	Germanium		Magnesium	0.05
Tungsten		Tellurium		Gallium	≤0.004	Sodium	4
Tantalum		Antimony		Zinc	0.1	Fluorine	≈0.06
Hafnium		Tin		Copper	0.06	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.3	Nitrogen	NR
Ytterbium		Cadmium	≤0.007	Cobalt	0.02	Carbon	NR
Thulium		Silver	MC	Iron	2	Boron	0.9
Erbium		Palladium		Manganese	0.09	Beryllium	
Holmium		Rhodium		Chromium	1	Lithium	0.002
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.004 µg/ml

Approved: M Yeaks

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucible prior to analysis.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 330 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8494
Reply to: INSTRUMENTAL ANALYSIS DIVISION, 14333 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 13-18 E AVG. $\left(\frac{\#1+\#2}{2}\right)$

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.0055
Thorium		Gadolinium		Molybdenum	0.075	Titanium	0.035
Bismuth	< 0.008	Europium		Niobium		Scandium	< 0.002
Lead	0.03	Samarium		Zirconium	0.015	Calcium	2.5
Thallium		Neodymium		Yttrium		Potassium	4 < MC
Mercury	NR	Praseodymium		Strontium	0.0145	Chlorine	0.25
Gold		Cerium	0.005	Rubidium	0.0025	Sulfur	MC
Platinum		Lanthanum	0.01	Bromine	0.009	Phosphorus	0.65
Iridium		Barium	0.075	Selenium	< 0.015	Silicon	0.5
Osmium		Cesium	< 0.0025	Arsenic	< 0.003	Aluminum	0.4
Rhenium		Iodine	0.0045 < 0.0065	Germanium		Magnesium	0.275
Tungsten		Tellurium		Gallium	< 0.004	Sodium	4 < MC
Tantalum		Antimony		Zinc	0.09	Fluorine	0.05
Hafnium		Tin		Copper	0.13	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.45	Nitrogen	NR
Ytterbium		Cadmium	< 0.007	Cobalt	0.02	Carbon	NR
Thulium		Silver	MC	Iron	2	Boron	0.55
Erbium		Palladium		Manganese	0.075	Beryllium	
Holmium		Rhodium		Chromium	1	Lithium	0.0055
Dysprosium						Hydrogen	NR

NR – Not Reported

Approved: M Nicholas

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 330 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

To: Mr. John Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, New York
14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 13-18 G 420

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.2
Thorium		Gadolinium		Molybdenum	3	Titanium	2
Bismuth		Europium		Niobium		Scandium	≤0.004
Lead	≤2	Samarium		Zirconium	3	Calcium	30
Thallium		Neodymium		Yttrium		Potassium	29
Mercury	NR	Praseodymium		Strontium	≤0.3	Chlorine	2
Gold		Cerium		Rubidium		Sulfur	4
Platinum		Lanthanum		Bromine		Phosphorus	13
Iridium		Barium	≤1	Selenium		Silicon	40
Osmium		Cesium		Arsenic	≤0.3	Aluminum	2
Rhenium		Iodine		Germanium		Magnesium	20
Tungsten		Tellurium		Gallium		Sodium	30
Tantalum		Antimony		Zinc	4	Fluorine	≈5
Hafnium		Tin		Copper	1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.7	Nitrogen	NR
Ytterbium		Cadmium	≤1	Cobalt	≤0.1	Carbon	NR
Thulium		Silver	≤0.8	Iron	2	Boron	4
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	3	Lithium	0.2
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.5 ppm weight

Approved: M Stacoks

Sample was thermally ashed @400° C for in a laboratory oven in a quartz crucible prior to analysis

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 330 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484

Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, New York
14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 13-18 H 339

IAD No.: 97-A197-134-31

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.07	Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.05	Titanium	0.05
Bismuth		Europium		Niobium		Scandium	≤0.002
Lead	≤0.04	Samarium		Zirconium	0.05	Calcium	4
Thallium		Neodymium		Yttrium		Potassium	6
Mercury	NR	Praseodymium		Strontium	0.02	Chlorine	0.5
Gold		Cerium		Rubidium		Sulfur	MC
Platinum		Lanthanum		Bromine	0.02	Phosphorus	3
Iridium		Barium	0.02	Selenium	≤0.03	Silicon	1
Osmium		Cesium		Arsenic	≤0.004	Aluminum	0.1
Rhenium		Iodine		Germanium		Magnesium	270
Tungsten		Tellurium		Gallium		Sodium	8
Tantalum		Antimony		Zinc	0.06	Fluorine	≈0.2
Hafnium		Tin		Copper	0.05	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.1	Nitrogen	NR
Ytterbium		Cadmium	≤0.02	Cobalt	≤0.005	Carbon	NR
Thulium		Silver	MC	Iron	0.5	Boron	0.02
Erbium		Palladium		Manganese	0.04	Beryllium	
Holmium		Rhodium		Chromium	0.1	Lithium	0.005
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.008 µg/ml
Sample was thermally ashed @300° C for one hour in a laboratory oven in a quartz crucible

Approved: M Stacoles

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8494
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

Reply to

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 13-18 J 1032

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	2	Terbium	0.2	Ruthenium		Vanadium	10
Thorium	3	Gadolinium	0.5	Molybdenum	2	Titanium	430
Bismuth	≤0.3	Europium	0.3	Niobium	2	Scandium	2
Lead	60	Samarium	2	Zirconium	7	Calcium	MC
Thallium	0.7	Neodymium	4	Yttrium	2	Potassium	MC
Mercury	NR	Praseodymium	0.9	Strontium	530	Chlorine	MC
Gold		Cerium	10	Rubidium	95	Sulfur	MC
Platinum		Lanthanum	7	Bromine	19	Phosphorus	MC
Iridium		Barium	MC	Selenium	4	Silicon	MC
Osmium		Cesium	0.5	Arsenic	15	Aluminum	>170
Rhenium		Iodine	0.5	Germanium	2	Magnesium	MC
Tungsten	≤0.8	Tellurium	≤0.5	Gallium	12	Sodium	>420
Tantalum	≤0.3	Antimony	0.9	Zinc	MC	Fluorine	≈110
Hafnium	≤1	Tin	12	Copper	550	Oxygen	NR
Lutetium		Indium	STD	Nickel	23	Nitrogen	NR
Ytterbium		Cadmium	1	Cobalt	6	Carbon	NR
Thulium		Silver	27	Iron	MC	Boron	150
Erbium		Palladium	≤2	Manganese	MC	Beryllium	≤0.1
Holmium	0.4	Rhodium		Chromium	37	Lithium	0.9
Dysprosium	0.6					Hydrogen	NR

NR — Not Reported
All elements not reported <0.2 ppm weight

Approved: M Jacobs

Sample was thermally ashed for one hour @ 375° C for one hour in a laboratory furnace in a

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 789-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9881

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 13-18 K 1033 Boiler Ash

IAD No.: 97-A179-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	11	Terbium	0.6	Ruthenium		Vanadium	210
Thorium	27	Gadolinium	4	Molybdenum	2	Titanium	MC
Bismuth	≤0.2	Europium	2	Niobium	32	Scandium	33
Lead	6	Samarium	13	Zirconium	360	Calcium	MC
Thallium	0.4	Neodymium	39	Yttrium	46	Potassium	MC
Mercury	NR	Praseodymium	16	Strontium	560	Chlorine	18
Gold		Cerium	160	Rubidium	480	Sulfur	>870
Platinum		Lanthanum	97	Bromine	5	Phosphorus	MC
Iridium		Barium	MC	Selenium	4	Silicon	MC
Osmium		Cesium	17	Arsenic	2	Aluminum	MC
Rhenium		Iodine	0.1	Germanium	3	Magnesium	MC
Tungsten	0.8	Tellurium		Gallium	37	Sodium	MC
Tantalum	≤0.5	Antimony	0.4	Zinc	37	Fluorine	≈110
Hafnium	3	Tin	1	Copper	38	Oxygen	NR
Lutetium	0.5	Indium	STD	Nickel	39	Nitrogen	NR
Ytterbium	3	Cadmium	≤0.2	Cobalt	11	Carbon	NR
Thulium	0.2	Silver	0.1	Iron	MC	Boron	29
Erbium	1	Palladium		Manganese	140	Beryllium	0.5
Holmium	2	Rhodium		Chromium	400	Lithium	>390
Dysprosium	5					Hydrogen	NR

NR – Not Reported
All elements not reported <0.2ppm weight

Approved: M Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

Reply to

To: Mr. John Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, New York
14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 13-18L 1034 ESP Ash

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	14	Terbium	0.9	Ruthenium		Vanadium	100
Thorium	17	Gadolinium	2	Molybdenum	140	Titanium	MC
Bismuth	0.2	Europium	1	Niobium	12	Scandium	7
Lead	58	Samarium	9	Zirconium	140	Calcium	MC
Thallium	7	Neodymium	21	Yttrium	32	Potassium	MC
Mercury	NR	Praseodymium	7	Strontium	340	Chlorine	360
Gold		Cerium	56	Rubidium	110	Sulfur	MC
Platinum		Lanthanum	40	Bromine	4	Phosphorus	MC
Iridium		Barium	MC	Selenium	5	Silicon	MC
Osmium		Cesium	6	Arsenic	200	Aluminum	MC
Rhenium	≤0.1	Iodine	1	Germanium	17	Magnesium	MC
Tungsten	2	Tellurium	≤0.3	Gallium	25	Sodium	MC
Tantalum	≤0.8	Antimony	3	Zinc	420	Fluorine	≈85
Hafnium	2	Tin	3	Copper	50	Oxygen	NR
Lutetium	0.5	Indium	STD	Nickel	40	Nitrogen	NR
Ytterbium	2	Cadmium	0.9	Cobalt	10	Carbon	NR
Thulium	0.2	Silver	1	Iron	MC	Boron	230
Erbium	2	Palladium		Manganese	MC	Beryllium	
Holmium	3	Rhodium		Chromium	110	Lithium	54
Dysprosium	4					Hydrogen	NR

NR – Not Reported
All elements not reported <0.1 ppm weight

Approved: M Hacohs

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 13-24 Date 11-11-76 Location 13 - WOOD BARK BOILER

Sample Port Position DOWNSTREAM OF PRECIP. - COAL & WOOD FUEL
NO SEMS EXCEPT BLANKS

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment
	739	S P+N+10μ SOLIDS	4oz NYLGEN	0.4806g 23.9698	(23.9698, 23.9699, 23.9697)
	731	S 3μ SOLIDS	4oz NYLGEN	0.3527g 23.7166	(23.7164, 23.7167, 23.7166)
	735	S 1μ SOLIDS	4oz NYLGEN	1.2542 24.9466	(24.9464, 24.9467, 24.9466)
	284	S #1 FILTER	PETRI	1.18	TARE 134.8857 BROKEN
A*	476	L P+N+10μ WASH	8oz AMBER	204 ml	
	610	L " "	16oz AMBER	432 ml	
	608	L 3μ WASH	16oz AMBER	486 ml	
	611	L " "	16oz AMBER	192 ml	
	482	L 1μ WASH	8oz AMBER	231 ml	1847
	488	L " "	8oz AMBER	170 ml	
	494	L FILTER HOUSING WASH	8oz AMBER	132 ml.	
	609	L XAD-2 MODULE RINSE	16oz AMBER	298 ml	
B* NO POM PCB	531	S XAD-2 RESIN	WIDE MOUTH AMBER	167g	446-279
	266	L XAD-2 CONDENSATE	8oz AMBER	130 ml	735
	509	L " "	1l NYLGEN	605 ml	
	507	L IMPINGER #1	1l NYLGEN	968 ml	1176-1010 = 166 RWSE
	508	L " "	1l NYLGEN	208 ml	
	510	L IMPINGER #2	1l NYLGEN	982 ml	1105-735 = 310 RWSE
	505	L IMPINGER #3	1l NYLGEN	912 ml	
	269	L WATER WASH IMP #2	8oz AMBER	123 ml	1032-705 = 327 RWSE
	332	L " " " #3	8oz AMBER	120 ml	
⊗	724	SB XAD-2 RESIN BLANK	4oz NYLGEN	4.5381g 27.5364	(27.5367, 27.5364, 27.5361)
	503	LB 50-50 BLANK	1l NYLGEN	972 ml	
⊗	504	LB FREON BLANK	"	931 ml	
	506	LB IPA BLANK	"	1006 ml	
	679	LB H_2O_2 BLANK IMP #1	"	760 ml	SLIGHT BULGE ON BOTTOM

Data Sheet KVB 6002-15

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 13-24 Date 11/11-76 Location 13 - Wood-Bark Boiler

Sample Port Position Downstream of Precip. Coal & Wood Fuel

Container Number	Sample Description	Container Type	Net wt/vol.	Comment
1039	SF Coal Fuel			Dup
1035	SF Wood Fuel			
1036	SP Boiler Ash			
1037	SP ESP Ash			Dup
Count	S - 5	L-3	SD - 2AA, 1GC	
	SF - 2	LB-3	LD-0	
	SP - 2	6 Liquids		
	9 Solids + 2 Dup			
	15 Analyses + 2 Duplicates			
⊗	Do Not Analyze			
*	Combine			
B1	Sulf. & Nitrates Exclude 5		10,269,	905,332
	SSMS for 13-24	Blanks Only		
13-24A 503	LB 50/50 Rinse Blank	1 L N	972 ml	100%
13-24B 506	LB IPA Blank	"	1006 ml	100%
13-24C 679	LB Hexane Blank	"	760 ml	100%
	Count LB-3			

Data Sheet KVB 6002-15

13- Wood Bark Boiler

Test 13-24 TABLE Downstream of Precip.-coal & wood fuel

POLLUTANT	SAMPLE NUMBER							
	739+	731+	735+	284+	A*	609*	531+	B*
Antimony	<140	<170	<170	<100	<0.5	<0.5	<50	0.5
Arsenic	140	300	260	120	<0.010	<0.010	<3	<0.010
Barium	430	420	420	460	<0.05	<0.05	<3	<0.05
Beryllium	7	7	7	13	<0.005	<0.005	<0.5	<0.005
Cadmium	16	13	18	76	0.01	<0.01	<0.5	0.02
Calcium	100000	57000	65000	67000	100	<0.05	2000	0.29
Chromium	140	100	100	170	0.05	0.46	2.5	0.48
Cobalt	<70	<80	<80	<50	<0.05	<0.05	<25	<0.05
Copper	160	160	180	480	0.090	0.020	1.0	0.11
Iron	33000	31000	28000	21000	5.9	9.6	42	3.0
Lead	370	350	330	13000	0.13	<0.03	15	<0.03
Manganese	3900	4000	5000	3400	2.0	0.28	4	0.10
Mercury	1.4	<1.5	<1.5	1.0	<0.005	<0.005	<0.5	<0.005
Nickel	110	66	62	110	0.10	1.4	<1	0.41
Selenium	17	33	20	20	<0.01	<0.01	<5	<0.01
Tellurium	<70	<80	<80	<50	<5	<5	<25	<5
Tin	<700	<800	<800	<500	<1	<1	<250	<1
Titanium	4600	5700	4800	4400	<1	<1	55	700
Vanadium	130	120	130	210	<0.1	<0.1	<5	<0.1
Zinc	1300	1400	1500	7600	0.47	0.038	3	0.075
Chloride	—	—	130	—	2.12	10.9	26	7.44
Fluoride					<0.20	3.34		6.20
Nitrates	—	—	<5	—	1.08	0.22	8.0	<0.10
Sulfates	—	—	138000	—	45.0	5.0	220	20400
					476, 610, 608, 611, 482, 488, 494			266, 504, 507, 508, 510, 269, 505, 332

Test 13-24 TABLE Downstream of Precip.-coal & wood fuel

POLLUTANT	SAMPLE NUMBER							
	B_1*	503*	506*	679*	1039+	1039+ dupl	1035+	1036+
Antimony		<0.5	<0.5	<0.5	<50	<50	<50	<50
Arsenic		<0.010	<0.010	<0.010	<3	<3	<3	<3
Barium		<0.05	<0.05	<0.05	<3	10	<3	180
Beryllium		<0.005	<0.005	<0.005	1.5	1.0	<0.5	13
Cadmium		<0.01	<0.01	<0.01	<0.5	0.5	0.5	6.0
Calcium		<0.05	<0.05	<0.05	300	400	1800	18000
Chromium		<0.05	<0.05	<0.05	11	11	3	89
Cobalt		<0.05	<0.05	<0.05	<25	<25	<25	<25
Copper		<0.01	<0.01	0.11	4	4	1.5	42
Iron		<0.05	<0.05	<0.05	10000	14000	390	51000
Lead	no metals	0.05	<0.03	<0.03	10	10	5	30
Manganese		<0.01	<0.01	<0.01	17	17	110	170
Mercury		<0.005	<0.005	<0.005	<0.5	<0.5	<0.5	<0.5
Nickel		<0.05	<0.05	<0.05	2.5	7.5	<1	100
Selenium		<0.01	<0.01	<0.01	<5	<5	5	10
Tellurium		<5	<5	<5	<25	<25	<25	<25
Tin		<1	<1	<1	<250	<250	<250	<250
Titanium		<1	<1	<1	700	1200	120	14000
Vanadium		<0.1	<0.1	<0.1	15	15	<5	250
Zinc		<0.005	<0.005	0.021	10	11	19	35
Chloride	—	<0.3	<0.3	2.12	<13	<13	61.9	13.0
Fluoride	—	<0.20	<0.20	<0.20				
Nitrates	0.48	<0.10	<0.10	<0.10	11.0	12.0	14.8	5.0
Sulfates	17400	<5	<5	<5	3900	3250	<120	650

266, 504, 507, 508

13-Wood Bark Boiler

Test 13-24 TABLE Downstream of Precip.-coal & wood fuel

POLLUTANT	SAMPLE NUMBER							
	1037+	1037+ dupl.						
Antimony	<50	<50						
Arsenic	65	100						
Barium	300	320						
Beryllium	7.0	7.5						
Cadmium	3.0	3.5						
Calcium	19000	18000						
Chromium	68	64						
Cobalt	<25	<25						
Copper	60	58						
Iron	38000	44000						
Lead	130	100						
Manganese	730	870						
Mercury	<0.5	<0.5						
Nickel	45	50						
Selenium	<5	<5						
Tellurium	<25	<25						
Tin	<250	<250						
Titanium	6200	6100						
Vanadium	130	120						
Zinc	170	180						
Chloride	290	270						
Fluoride								
Nitrates	<5	<5						
Sulfates	26000	23300						

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 230 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303 278-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, New York
14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810 A

Sample No.: KVB 13-24 #503

IAD No.: 97-A197-134-31

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.06	Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.1	Titanium	0.05
Bismuth		Europium		Niobium		Scandium	≤0.001
Lead	≤0.04	Samarium		Zirconium	0.1	Calcium	1
Thallium		Neodymium		Yttrium		Potassium	*0.4
Mercury	NR	Praseodymium		Strontium	0.007	Chlorine	0.3
Gold		Cerium		Rubidium		Sulfur	0.2
Platinum		Lanthanum		Bromine	≤0.03	Phosphorus	0.3
Iridium		Barium	0.02	Selenium		Silicon	*1
Osmium		Cesium		Arsenic	≤0.004	Aluminum	*0.06
Rhenium		Iodine		Germanium		Magnesium	0.02
Tungsten		Tellurium		Gallium		Sodium	0.3
Tantalum		Antimony		Zinc	0.03	Fluorine	≈1
Hafnium		Tin		Copper	0.05	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium	≤0.01	Cobalt	≤0.003	Carbon	NR
Thulium		Silver		Iron	*0.1	Boron	0.02
Erbium		Palladium		Manganese	0.002	Beryllium	
Holmium		Rhodium		Chromium	0.005	Lithium	0.001
Dysprosium						Hydrogen	NR

NR – Not Reported

All elements not reported <0.008 µg/ml

Approved:

*Heterogeneous - Sample was thermally ashed @350° C for one hour in a laboratory oven

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 630 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810 B

Sample No.: KVB 13-24 506

IAD No.: 97-A197-134-31

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.002
Thorium		Gadolinium		Molybdenum	0.09	Ttanium	0.03
Bismuth		Europium		Niobium		Scandium	≤0.001
Lead	≤0.03	Samarium		Zirconium	0.07	Calcium	1
Thallium		Neodymium		Yttrium		Potassium	0.6
Mercury	NR	Praseodymium		Strontium	0.003	Chlorine	0.3
Gold		Cerium		Rubidium		Sulfur	0.1
Platinum		Lanthanum		Bromine	≤0.02	Phosphorus	0.6
Iridium		Barium	0.03	Selenium		Silicon	0.6
Osmium		Cesium		Arsenic	≤0.004	Aluminum	0.008
Rhenium		Iodine	≤0.008	Germanium		Magnesium	0.5
Tungsten		Tellurium		Gallium	≤0.006	Sodium	0.2
Tantalum		Antimony		Zinc	0.05	Fluorine	≈0.1
Hafnium		Tin		Copper	0.008	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.005	Nitrogen	NR
Ytterbium		Cadmium	≤0.01	Cobalt	≤0.001	Carbon	NR
Thulium		Silver	0.01	Iron	0.2	Boron	0.02
Erbium		Palladium		Manganese	0.003	Beryllium	
Holmium		Rhodium		Chromium	0.009	Lithium	0.005
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.007 µg/ml

Approved:

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucible prior to analysis.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 738-0434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14333 WEST 64TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810 C

Sample No.: 18 KVB 13-24 679

IAD No.: 97-A197-134-31

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC
Uranium		Terbium		Ruthenium		Vanadium	0.1
Thorium		Gadolinium		Molybdenum	0.04	Titanium	0.02
Bismuth		Europium		Niobium		Scandium	≤0.001
Lead	≤0.02	Samarium		Zirconium	0.03	Calcium	3
Thallium		Neodymium		Yttrium		Potassium	0.5
Mercury	NR	Praseodymium		Strontium	0.04	Chlorine	0.2
Gold		Cerium		Rubidium		Sulfur	0.3
Platinum		Lanthanum		Bromine		Phosphorus	1
Iridium		Barium	0.04	Selenium		Silicon	**4
Osmium		Cesium		Arsenic	≤0.002	Aluminum	0.4
Rhenium		Iodine	≤0.005	Germanium		Magnesium	0.4
Tungsten		Tellurium		Gallium	≤0.003	Sodium	1
Tantalum		Antimony		Zinc	0.7	Fluorine	≈0.2
Hafnium		Tin		Copper	0.2	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.03	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.001	Carbon	NR
Thulium		Silver	0.02	Iron	0.05	Boron	0.04
Erbium		Palladium		Manganese	0.001	Beryllium	
Holmium		Rhodium		Chromium	**0.3	Lithium	<0.003
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported < 0.004 µg/ml

Approved: M J Jacobs

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz cruc

KVB ANALYSIS DATA

SAMPLE	POM's	PCB's
12/2 - 3 B	< 10 ug/l	< 1 ug/l
12/2 - 6 E	10 ug/l	< 1 ug/l
13/18 M	2480 ug/l	< 10 ug/l
13/18 M deep	2890 ug/l	< 10 ug/l
13/18 N	225 ug/l	< 10 ug/l
13/24 609	234 ug/l	< 10 ug/l
13/24 A	10 ug/l	< 5 ug/l
14 616	27 ug/l	< 10 ug/l

12/2-3 B	374, 376, 377
12/2-6 E	343-345, 350
13/18 M	605, 606, 607, 333
13/18 N	264, 331
13/24 A	476, 610, 608, 611, 482, 488, 494

KVB Analysis Data

Test	Sample Number	POM's	PCB's
✓12/2-3	298	< 1 ug/g	< 1 ug/g
12/2-6	534	< 1 ug/g	< 1 ug/g
	534 (duplicate)	< 1 ug/g	< 1 ug/g
13-18	740	90 ug/g	< 1 ug/g
13-18	282	49 ug/g	< 1 ug/g
13-18	530	3.2 ug/g	< 1 ug/g
13-18	1038	6.3 ug/g	< 1 ug/g
13-18	1032	396 ug/g	< 1 ug/g
13-18	1033	1 ug/g	< 1 ug/g
13-18	1034	8 ug/g	< 1 ug/g
13-18	1034 (duplicate)	9 ug/g	< 1 ug/g
13-24	735	513 ug/g	< 1 ug/g
	531	6.9 ug/g	< 1 ug/g
	1039	20 ug/g	< 1 ug/g
	1035	144 ug/g	< 1 ug/g
	1036	10 ug/g	< 1 ug/g
	1037	7.1 ug/g	< 1 ug/g
	1037 (duplicate)	8.5 ug/g	< 1 ug/g
14	556	70.5 ug/g	< 1 ug/g
	568	104 ug/g	< 1 ug/g
	532	10.7 ug/g	< 1 ug/g
	532 (duplicate)	8.2 ug/g	< 1 ug/g
15-10	1041	< 0.1 ug/g	< 1 ug/g
	1041 (duplicate)	< 0.1 ug/g	< 1 ug/g
	1042	*	*
15-11	941	< 1 ug/l	< 1 ug/l
	1044	< 0.1 ug/g	< 1 ug/g
	1045	*	*
19-1	LF	*	*
19-2	533	< 0.1 ug/g	< 1 ug/g
	533 (duplicate)	< 0.1 ug/g	< 1 ug/g
	C	< 1 ug/l	< 1 ug/l
	C (duplicate)	< 1 ug/l	< 1 ug/l
	LF	*	*

*Sample extracts too concentrated to be able to determine an analytical value.

OPEN HEARTH FURNACE

Location No. 14 Unit No. 43

Unit Description OPEN HEARTH FURNACE
BALANCED DRAFT
34090 kg per heat (375 tons per heat)
The charge for normal operations is 30% hot metal and 70% scrap metal.

Installation Date 1952

Heater Rating 57 MW (195 x 10⁶ Btu/hr)

Burner Description 8 burners - 6 in roof and 1 at each end
INLAND.

Test Fuel Combinations NAT. GAS AND No 6 OIL (1.34% SULFUR)

Fuel Temp. at Burner (°F) [illegible] for No 6 Oil

Primary Air Temp. (°F) 1311 K (1900°F)

Comments:

MOBILE LABORATORY DATA Test No._____

Test No. 14-1 Date 11-17-76 Location #14 Engr. BWH

Unit No._____ Fuel OIL/GAS Capacity_____

Unit Type OPEN HEARTH FURNACE Burner Type_____

1. Test No.	14-1		14-1		14-1		14-1		14-1	
2. Date	11-17-76		11-17-76		11-17-76		11-17-76		11-17-76	
3. Time	1300		1330		1400		1430		1500	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft	ϕ9'-6"									
7. Probe Position	CENTER		CENTER		CENTER		CENTER		CENTER	
8. Oxygen (%)	14.5		14.25		15.25		14.5		11.0	
9. NOx (hot) read/3% O_2 (ppm)	920	2548	475	1267	500	1565	—	—	—	—
10. NO (hot) read/3% O_2 (ppm)	900	2492	475	1267	500	1565	500	1385	—	—
11. NO_2 (hot) read/3% O_2 (ppm)	20	56	0	0	0	0	—	—	—	—
12. NO (cold) read/3% O_2 (ppm)	800	2215	500	1333	525	1643	525	1454	50	90
13. Carbon Dioxide (%)	—		—		—		—		—	
14. Carbon Monoxide (ppm) uncor/cor	10	28	6	16	14	44	16	44	>2000	>3600
15. Hydrocarbon (ppm) uncor/cor	10	28	20	53	20	63	10	28	5	9
16. Sulfur Dioxide (ppm) uncor/cor	20	55	20	53	20	63	40	111	1620	2916
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. ~~Atmos. Temp.~~ DRY BULB (°F/°C)	51		—		52		—		52	
19. Dew Point Temp. (°F/°C)	44		—		46		—		45	
20. Atmos. Pressure (in. Hg)	30.31		30.30		30.29		30.28		30.26	
21. Relative Humidity (%)	57		—		63		—		58	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 14-1 Date 11-17-76 Location #14 Engr. BWH

Unit No. _____ Fuel OIL/GAS Capacity _____

Unit Type OPEN HEARTH FURNACE Burner Type _____

1. Test No.	14-1		14-1		14-1		14-1		14-1	
2. Date	11-17-76		11-17-76		11-17-76		11-17-76		11-17-76	
3. Time	1530		1600		1605		1630		1700	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	14.75		15.5		15.4		13.75		13.75	
9. NOx (hot) read/3% O_2 (ppm)	800	2304	—	—	675	2170	—	—	1125	2793
10. NO (hot) read/3% O_2 (ppm)	800	2304	—	—	675	2170	725	1800	1075	2668
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	—	—	0	0	—	—	50	125
12. NO (cold) read/3% O_2 (ppm)	725	2088	625	2045	688	2211	700	1738	950	2359
13. Carbon Dioxide (%)	—		—		—		—		—	
14. Carbon Monoxide (ppm) uncor/cor	14	40	8	26	12	39	12	30	12	30
15. Hydrocarbon (ppm) uncor/cor	8	23	8	26	8	26	12	30	5	12
16. Sulfur Dioxide (ppm) uncor/cor	30	86	20	65	40	129	50	124	40	99
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. ~~Atmos. Temp.~~ DRY BULB (°F)/°C)	—		53		53		—		51	
19. Dew Point Temp. (°F)/°C)	—		45		45		—		44	
20. Atmos. Pressure (in. Hg)	30.27		30.29		30.29		30.29		30.29	
21. Relative Humidity (%)	—		54		54		—		57	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 14-1 Date 11-17-76 Location #14 Engr. BWH

Unit No. _____ Fuel OIL/GAS Capacity _____

Unit Type OPEN HEARTH FURNACE Burner Type _____

1. Test No.	14-1		14-1		14-1		14-1		14-1	
2. Date	11-17-76		11-17-76		11-17-76		11-17-76		11-17-76	
3. Time	1730		1800		1830		1900		1930	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	CENTER		CENTER		CENTER		CENTER		CENTER	
8. Oxygen (%)	15.25		20.1		14.75		15.6		13.5	
9. NOx (hot) read/3% O_2 (ppm)	1175	3678	—	—	275	792	1200	4000	325	780
10. NO (hot) read/3% O_2 (ppm)	1163	3641	—	—	275	792	1150	3833	325	780
11. NO_2 (hot) read/3% O_2 (ppm)	12	37	—	—	0	0	50	167	0	0
12. NO (cold) read/3% O_2 (ppm)	1025	3209	12.5	250	275	792	1025	3417	400	960
13. Carbon Dioxide (%)	—		—		—		—		—	
14. Carbon Monoxide (ppm) uncor/cor	10	31	6	120	8	23	7	23	8	19
15. Hydrocarbon (ppm) uncor/cor	12	38	10	200	10	29	8	27	—	—
16. Sulfur Dioxide (ppm) uncor/cor	40	125	20	400	20	58	20	67	20	48
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. ~~Atmos. Temp.~~ DRY BULB (°F)°C)	—		52		—		49		—	
19. Dew Point Temp. (°F)°C)	—		45		—		43		—	
20. Atmos. Pressure (in. Hg)	30.29		30.29		30.28		30.29		30.29	
21. Relative Humidity (%)	—		58		—		61		—	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 14-2 Date 11-18-76 Location #14 Engr. BWH

Unit No. _____ Fuel OIL/GAS Capacity _____

Unit Type OPEN HEARTH FURNACE Burner Type _____

1. Test No.	14-2		14-2		14-2		14-2		14-2	
2. Date	11-18-76		11-18-76		11-18-76		11-18-76		11-18-76	
3. Time	1245		1315		1345		14-15		1445	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	CENTER		CENTER		CENTER		CENTER		CENTER	
8. Oxygen (%)	15.63		15.1		16.5		12.6		15.0	
9. NOx (hot) read/3% O_2 (ppm)	530	1775	290	885	—	—	—	—	1413	4239
10. NO (hot) read/3% O_2 (ppm)	510	1708	290	885	—	—	290	261	1363	4089
11. NO_2 (hot) read/3% O_2 (ppm)	20	67	0	0	—	—	—	—	50	150
12. NO (cold) read/3% O_2 (ppm)	565	1892	320	976	670	2680	320	686	1188	3564
13. Carbon Dioxide (%)	—		—		—		—		—	
14. Carbon Monoxide (ppm) uncor/cor	2	7	4	12	3	12	2	4	4	12
15. Hydrocarbon (ppm) uncor/cor	8	27	5	15	10	40	10	21	10	30
16. Sulfur Dioxide (ppm) uncor/cor	20	67	20	61	20	80	20	43	10	30
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. ~~Atmos. Temp.~~ DRY BULB (°F)/°C)	—		54		—		55		—	
19. Dew Point Temp. (°F)/°C)	—		43		—		44		—	
20. Atmos. Pressure (in. Hg)	30.30		30.28		30.23		30.22		30.19	
21. Relative Humidity (%)	—		39		—		40		—	
22.	BASELINE SMSS.									
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 14-2 Date 11-18-76 Location #14 Engr. BWH

Unit No. _____ Fuel OIL/GAS Capacity _____

Unit Type OPEN HEARTH FURNACE Burner Type _____

1. Test No.	14-2		14-2		14-2		14-2			
2. Date	11-18-76		11-18-76		11-18-76		11-18-76			
3. Time	1515		1545		1615		1635			
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	CENTER		CENTER		CENTER		CENTER			
8. Oxygen (%)	13.8		13.25		11.9		11.25			
9. NOx (hot) read/3% O_2 (ppm)	—	—	555	1289	11	22	1	2		
10. NO (hot) read/3% O_2 (ppm)	—	—	555	1289	10	20	1	2		
11. NO_2 (hot) read/3% O_2 (ppm)	—	—	0	0	1	2	0	0		
12. NO (cold) read/3% O_2 (ppm)	780	1950	580	1347	25	49	5	9		
13. Carbon Dioxide (%)	—		—		—		—			
14. Carbon Monoxide (ppm) uncor/cor	8	20	8	19	12	24	220	406		
15. Hydrocarbon (ppm) uncor/cor	5	13	12	28	10	20	12	22		
16. Sulfur Dioxide (ppm) uncor/cor	10	25	30	70	50	158	120	222		
17. Smoke Spot (Bacharach)	—		—		—		—			
18. ~~Atmos. Temp.~~ DRY BULB (°F)/°C)	58		—		58		60			
19. Dew Point Temp. (°F)/°C)	46		—		46		48			
20. Atmos. Pressure (in. Hg)	30.19		30.19		30.19		30.18			
21. Relative Humidity (%)	37		—		37		39			
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

BASELINE SASS.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 14-3 Date _____ Location #14 Engr. BWH

Unit No. _____ Fuel OIL/GAS Capacity _____

Unit Type OPEN HEARTH FURNACE Burner Type _____

1. Test No.	14-3		14-3		14-3		14-3		14-3	
2. Date	12-23-76		12-23-76		12-23-76		12-23-76		12-23-76	
3. Time	1230		1300		1330		1400		1430	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	CENTER		CENTER		CENTER		CENTER		CENTER	
8. Oxygen (%)	15.5		15.5		15.25		14.6		13.6	
9. NOx (hot) read/3% O_2 (ppm)	1625	5318	400	1309	450	1409	525	1477	450	1095
10. NO (hot) read/3% O_2 (ppm)	1575	5154	400	1309	450	1409	525	1477	450	1095
11. NO_2 (hot) read/3% O_2 (ppm)	50	164	0	0	0	0	0	0	0	0
12. NO (cold) read/3% O_2 (ppm)	1325	4336	412	1350	438	1371	575	1617	475	1155
13. Carbon Dioxide (%)	—		—		—		—		—	
14. Carbon Monoxide (ppm) uncor/cor	8	26	6	20	5	16	6	17	10	24
15. Hydrocarbon (ppm) uncor/cor	5	16	15	49	15	47	5	14	10	24
16. Sulfur Dioxide (ppm) uncor/cor	0	0	20	66	10	31	20	56	20	49
17. Smoke Spot (Bacharach)	—				—		—		—	
18. Atmos. Temp. (DRY BULB (°F)/°C)	30				31					
19. Dew Point Temp. (°F)/°C)	28				28					
20. Atmos. Pressure (in. Hg)	30.75				30.74					
21. Relative Humidity (%)	—				—					
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.	BASELINE PARTICULATES		BASELINE PARTICULATES		BASELINE PARTICULATES		BASELINE PARTICULATES		BASELINE PARTICULATES	

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 14-3 Date 11-23-76 Location #14 Engr. BWH

Unit No. _____ Fuel GAS/OIL Capacity _____

Unit Type OPEN HEARTH FURNACE Burner Type _____

1. Test No.	14-3											
2. Date	11-23-76											
3. Time	1500											
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	CENTER											
8. Oxygen (%)	13.4											
9. NOx (hot) read/3% O_2 (ppm)	475	1125										
10. NO (hot) read/3% O_2 (ppm)	475	1125										
11. NO_2 (hot) read/3% O_2 (ppm)	0	0										
12. NO (cold) read/3% O_2 (ppm)	475	1125										
13. Carbon Dioxide (%)	—											
14. Carbon Monoxide (ppm) uncor/cor	12	28										
15. Hydrocarbon (ppm) uncor/cor	10	24										
16. Sulfur Dioxide (ppm) uncor/cor	40	95										
17. Smoke Spot (Bacharach)	—											
18. ~~Atmos. Temp.~~ DRY BULB (°F)/°C)	31											
19. Dew Point Temp. (°F)/°C)	28											
20. Atmos. Pressure (in. Hg)	30.71											
21. Relative Humidity (%)	—											
22.												
23.												
24.												
25.												
26.	BASELINE											
27.	BRINK											
28.												
29.												
30.												

MOBILE LABORATORY DATA

Test No._____

Test No._____ Date_____ Location 14 Engr. MBH/RP

Unit No._____ Fuel NG + N°6 Capacity —

Unit Type OPEN HEARTH Burner Type —

1. Test No.	BASELINE		—		—		—		→	
2. Date	3-29-77		—		—		—		→	
3. Time	1000		1030		1100		1130		1200	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	CENTER		—		—		—		→	
8. Oxygen (%)	15.4		17.0		16.0		15.6		14.5	
9. NOx (hot) read/3% O_2 (ppm)	800	2571	1113	5008	*		750	2499	800	2215
10. NO (hot) read/3% O_2 (ppm)	775	2491	1088	4896	975	3510	713	2376	750	2076
11. NO_2 (hot) read/3% O_2 (ppm)	75	241	125	563	*		37	123	50	138
12. NO (cold) read/3% O_2 (ppm)	700	2250	863	3883	850	3060	638	2126	663	1836
13. Carbon Dioxide (%)	4.4		2-8		4.2		4.3		4.1	
14. Carbon Monoxide (ppm) uncor/cor	0	0	~10	45	~10	36	~10	33	~15	42
15. Hydrocarbon (ppm) uncor/cor										
16. Sulfur Dioxide (ppm) uncor/cor	~20	64	~20	90	~20	72	~40	133	~20	55
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	68		—		72		—		73	
19. Dew Point Temp. (°F/°C)	55		—		56		—		56	
20. Atmos. Pressure (in. Hg)	29.50		—		29.51		—		29.51	
21. Relative Humidity (%)	44		—		40		—		35	
22.										
23. * UNIT CYCLED, NO NO_x										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. _____ Date _____ Location 14 Engr. MBH/RP

Unit No. _____ Fuel NG + No 6 Capacity —

Unit Type OPEN HEARTH Burner Type —

1. Test No.	BASELINE	→								
2. Date	3-29-77	→								
3. Time	1230		1300		1330		1400		1430	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	CENTER	→								
8. Oxygen (%)	14.5		15.8		14.7		13.8		14.9	
9. NOx (hot) read/3% O_2 (ppm)	675	1869			1025	2928	550	1375	1175	3467
10. NO (hot) read/3% O_2 (ppm)	600	1661			1000	2857	500	1250	1150	3393
11. NO_2 (hot) read/3% O_2 (ppm)	75	207			25	71	50	125	25	73
12. NO (cold) read/3% O_2 (ppm)	650	1800	500	1730	800	2286	400	1000	925	2729
13. Carbon Dioxide (%)	*		—		4.4		5.0		3.4	
14. Carbon Monoxide (ppm) uncor/cor	~10	28	~10	35	~10	29	~10	25	~5	15
15. Hydrocarbon (ppm) uncor/cor										
16. Sulfur Dioxide (ppm) uncor/cor	~20	55	~20	69	~20	57	~40	100	~40	118
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	—		72		—		72		—	
19. Dew Point Temp. (°F/°C)	—		55		—		55		—	
20. Atmos. Pressure (in. Hg)	—		29.55		—		29.56		—	
21. Relative Humidity (%)	—		34		—		34		—	
22.										
23.			UNIT							
24.			CYCLING							
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No._____ Date_____ Location 14 Engr. R.G.P/MBH

Unit No._____ Fuel NG + N°6 Capacity_____

Unit Type OPEN HEARTH Burner Type_____

1. Test No.	BASELINE		→		→		→		→	
2. Date	3-29-77		→		→		→		→	
3. Time	1500		1530		1600		1630		1700	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	CENTER		→		→		→		→	
8. Oxygen (%)	20.6		16.25		15.75		15.75		15.0	
9. NOx (hot) read/3% O_2 (ppm)	0	*	850	3221	575	1971			750	2250
10. NO (hot) read/3% O_2 (ppm)	0	—	800	3032	550	1886			725	2175
11. NO_2 (hot) read/3% O_2 (ppm)	0	—	50	190	25	86			25	75
12. NO (cold) read/3% O_2 (ppm)	0	—	700	2653	500	1714	300	1029	750	2250
13. Carbon Dioxide (%)	0		5.5		6.9		3.0		4.1	
14. Carbon Monoxide (ppm) uncor/cor	0	—	4	15	4	14	4	14	4	12
15. Hydrocarbon (ppm) uncor/cor										
16. Sulfur Dioxide (ppm) uncor/cor	0	—	0	0	0	0	20	69	10	30
17. Smoke Spot (Bacharach)	NA		→		→		→		→	
18. Atmos. Temp. (°F/°C)	70		—		70		—		71	
19. Dew Point Temp. (°F/°C)	56		—		55		—		56	
20. Atmos. Pressure (in. Hg)	29.58		—		29.59		—		29.61	
21. Relative Humidity (%)	42		—		39		—		40	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*MAKING BOTTOM 773

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No._____ Date_____ Location 14 Engr. R.G.P. + MBH

Unit No._____ Fuel NG + #6 oil Capacity_____

Unit Type OPEN HEARTH Burner Type_____

1. Test No.	BASELINE											
2. Date	3-29-77											
3. Time	1730											
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	CENTER											
8. Oxygen (%)	15.0											
9. NOx (hot) read/3% O_2 (ppm)	950	2850										
10. NO (hot) read/3% O_2 (ppm)	950	2850										
11. NO_2 (hot) read/3% O_2 (ppm)	0	0										
12. NO (cold) read/3% O_2 (ppm)	775	2325										
13. Carbon Dioxide (%)	7.1											
14. Carbon Monoxide (ppm) uncor/cor	4	12										
15. Hydrocarbon (ppm) uncor/cor												
16. Sulfur Dioxide (ppm) uncor/cor	0	0										
17. Smoke Spot (Bacharach)	NA											
18. Atmos. Temp. (°F/°C)	—											
19. Dew Point Temp. (°F/°C)	—											
20. Atmos. Pressure (in. Hg)	—											
21. Relative Humidity (%)	—											
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

MOBILE LABORATORY DATA

Test No._____

Test No._____ Date 3-30-77 Location 14 Engr. MBH/RP

Unit No._____ Fuel #6 + NG Capacity_____

Unit Type OPEN HEARTH Burner Type_____

1. Test No.	LOW O_2		→		→		→		→		→	
2. Date	3-30-77		→		→		→		→		→	
3. Time	0900		0930		1000		1030		1100			
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	CENTER		→		→		→		→			
8. Oxygen (%)	15.4		13.7		18		15.25		20.25			
9. NOx (hot) read/3% O_2 (ppm)	488	1569	—	—	—	—	1375	4304	0	—		
10. NO (hot) read/3% O_2 (ppm)	475	1526	263	648	300	1800	1350	4226	0	—		
11. NO_2 (hot) read/3% O_2 (ppm)	13	42	—	—	—	—	25	78	0	—		
12. NO (cold) read/3% O_2 (ppm)	463	1488	238	587	300	1800	1110	3475	0	—		
13. Carbon Dioxide (%)	4.6		6.0		3.2		3.3		0			
14. Carbon Monoxide (ppm) uncor/cor	8	26	8	20	6	36	4	13	0	—		
15. Hydrocarbon (ppm) uncor/cor	—	—	—	—	—	—	—	—	—	—		
16. Sulfur Dioxide (ppm) uncor/cor	~5	16	0	0	0	0	10	31	0	—		
17. Smoke Spot (Bacharach)	NA		→		→		→		→			
18. Atmos. Temp. (°F/°C)	60		—		65		—		65			
19. Dew Point Temp. (°F/°C)	53		—		56		—		55			
20. Atmos. Pressure (in. Hg)	29.58		—		29.58		—		29.56			
21. Relative Humidity (%)	63		—		58		—		54			
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

CHARGING OVEN

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. _____ Date 3-30-77 Location 14 Engr. MBH/RP

Unit No. _____ Fuel NG + N°6 Capacity _____

Unit Type OPEN HEARTH Burner Type _____

1. Test No.	LOW O_2		→		→		→		→	
2. Date	3-30-77		→		→		→		→	
3. Time	1130		1200		1230		1300		1330	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	CENTER		→		→		→		→	
8. Oxygen (%)	17		15.75		15.0		14.2		14.7	
9. NOx (hot) read/3% O_2 (ppm)	300	1350	475	1629	563	1689	300	794	710	1751
10. NO (hot) read/3% O_2 (ppm)	250	1125	450	1543	525	1575	275	728	690	1701
11. NO_2 (hot) read/3% O_2 (ppm)	50	225	25	86	38	114	25	66	20	49
12. NO (cold) read/3% O_2 (ppm)	250	1125	375	1286	313	939	250	662	510	1504
13. Carbon Dioxide (%)	2.6		4.4		4.6		6.1		6.0	
14. Carbon Monoxide (ppm) uncor/cor	4	18	6	21	6	18	8	21	8	20
15. Hydrocarbon (ppm) uncor/cor	–	–	–	–	–	–	–	–	–	–
16. Sulfur Dioxide (ppm) uncor/cor	10	45	10	34	20	60	15	40	10	25
17. Smoke Spot (Bacharach)	NA		→		→		→		→	
18. Atmos. Temp. (°F/°C)	–		67		–		70		–	
19. Dew Point Temp. (°F/°C)	–		56		–		56		–	
20. Atmos. Pressure (in. Hg)	–		29.54		–		29.55		–	
21. Relative Humidity (%)	–		51		–		42		–	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

MOBILE LABORATORY DATA

Test No. _____

Test No. _____ Date 3-30-77 Location 14 Engr. MBH/RP

Unit No. _____ Fuel NG + №6 Capacity _____

Unit Type OPEN HEARTH Burner Type _____

1. Test No.	LOW O_2	→								
2. Date	3-30-77	→								
3. Time	1400		1430		1500		1530		1600	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	CENTER	→								
8. Oxygen (%)	14.5		13.9		14.5		14.0			
9. NOx (hot) read/3% O_2 (ppm)	925	2562	350	887	362	1003	CYCLE			
10. NO (hot) read/3% O_2 (ppm)	800	2215	325	824	350	969				
11. NO_2 (hot) read/3% O_2 (ppm)	125	346	25	63	12	34				
12. NO (cold) read/3% O_2 (ppm)	750	2076	300	761	325	900	250	643		
13. Carbon Dioxide (%)	5.8		7.3		6.4		6.6			
14. Carbon Monoxide (ppm) uncor/cor	6	17	8	20	6	16.6	8	21		
15. Hydrocarbon (ppm) uncor/cor	—	—	—	—	—	—	—	—	—	—
16. Sulfur Dioxide (ppm) uncor/cor	10	28	15	38	20	55	0	0		
17. Smoke Spot (Bacharach)	NA	→								
18. Atmos. Temp. (°F/°C)	69				67					
19. Dew Point Temp. (°F/°C)	55				53					
20. Atmos. Pressure (in. Hg)	29.54				29.54					
21. Relative Humidity (%)	42				40					
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

OPERATING DATA

Location 14

Open Hearth

Test No.	14-1	14-1	14-1	14-1	14-1
Date	NOV. 17, 1976	NOV. 17, 1976	NOV. 17, 1976	NOV. 17, 1976	NOV. 17, 1976
Time	13:00	13:30	14:00	14:30	15:00
Gas Flow (cfh x 1000)	79.0	79.0	54.5	55	56
Furn. Press., in. H_2O	+1.05	+1.1	+1.05	+1.1	+1.0
Air Flow, (cfm) x 10^3	23-25	23-25	23-25.5	23-25.5	23-25.5
Oxygen Flow, (cfh) x 10^3	38	84	76	82	83
Oxygen Flow integr.	8365.9	8367.0	8369	8370.5	8372.8
Atom. Steam Flow, lb/hr	—	—	12.5	12	0
Atom. Steam integr.	—	—	3538	3539.2	3540
Atom. Steam, lb/gal setpoint	2.5	2.5	6.1	6.1	6.1
Gas Flow, % of total Btu	60	60	60	60	60
Total Btu/hr x 10^6	138	138	138	104	107
Oil Flow, GPH	390	390	320	320	330
Total Btu integr.	1750.0	1752	1754.6	1756.3	1758
Checker Temp., °F	1650-2000	1640-2000	1680-1900	1680-1920	1760-2000
Bath Temp., °F	—	—	—	—	2591 @ 14:45
Oil Press., psig	40	40	70	67	50
Oil Flow integr.	264510	264656	264831	264962	265106
O_2 at North Bridgewall					
CO at North Bridgewall					
Time of Measurements at North Bridgewall					

Comments: 11-17-76
STARTED CHARGING @ 11:00
FINISHED CHARGING SCRAP @ 12:00
START CHARGING HOT METAL @ 13:00
FINISH 13:40

52% HOT METAL, 48% SCRAP
TOTAL 385 TONS

OPERATING DATA

Location 14

Open Hearth

Test No.	14-1	14-1	14-1	14-1	14-1
Date	11-17-76	11-17-76	11-17-76	11-17-76	11-17-77
Time	1530	1600	1630	1700	1743
Gas Flow (cfh x 1000)	55	55	75	84	54
Furn. Press., in. H_2O	+.95	+.95	+1.0	+.95	+.95
Air Flow, (cfm) x 10^3	23-25.5	23-26	21-25	25-28	16-18
Oxygen Flow, (cfh) x 10^3	83	85	82	47	0
Oxygen Flow integr.	8374.8	8376.6	8378.6	8380.0	8380.2
Atom. Steam Flow, lb/hr	—	—	—	—	—
Atom. Steam integr.	3540.7	3541.7	3541.9	3542.1	3542.3
Atom. Steam, lb/gal setpoint	6.0	5.1	5.1	4.9	4.4
Gas Flow, % of total Btu	60	60	60	60	60
Total Btu/hr x 10^6	104	105	110	146	105
Oil Flow, GPH	320	310	350	400	320
Total Btu integr.	1759.5	1761.4	1763.6	1765.4	1769
Checker Temp., °F	1780-2080	1780-2000	1760-2100	1760-2120	1780-1980
Bath Temp., °F	2660@15:15	2710@15:40	2725@16:15 2805@16:35	2845@17:00	—
Oil Press., psig	67	35	45	80	70
Oil Flow integr.	265213	265364	265522	265674	265919
O_2 at North Bridgewall					
CO at North Bridgewall					
Time of Measurements at North Bridgewall					

Comments: 17:20 TAP
17:45 COATING BOTTOM OF HEATER. NO FIRE.

OPERATING DATA

Location 14

Open Hearth

Test No.	14-1	14-1	14-1	14-1	
Date	11-17-77	11-17-77	11-17-77	11-17-77	
Time	18:00	18:30	19:00	20:00	
Gas Flow (cfh x 1000)	0	119	55	85	
Furn. Press., in. H_2O	+.6	+1.1	+1.05	+1.1	
Air Flow, (cfm) x 10^3	0	33-35	25-26	23-25	
Oxygen Flow, (cfh) x 10^3	0	0	36	36	
Oxygen Flow integr.	8380.2	8380.5	8380.9	8381.5	
Atom. Steam Flow, lb/hr	—	—	—	—	
Atom. Steam integr.	3542.3	3542.2	3543.3	3543.6	
Atom. Steam, lb/gal setpoint	4.4	5.0	4.0	4.0	
Gas Flow, % of total Btu	60	60	60	60	
Total Btu/hr x 10^6	0	192	62	153	
Oil Flow, GPH	0	500	0	435	
Total Btu integr.	1769	1772.3	1774.5	1776.4	
Checker Temp., °F	1620-1750	1640-1870	1710-1900	1700-2000	
Bath Temp., °F	—	—	—	—	
Oil Press., psig	—	40	—	55	
Oil Flow integr.	265925	266126	266269	266389	
O_2 at North Bridgewall					
CO at North Bridgewall					
Time of Measurements at North Bridgewall					

Comments: 18:15 STARTED CHARGING SCRAP
19:00 FINISHED CHARGING SCRAP
19:15 STARTED CHARGING HOT METAL

NO OIL FLOW
ROOF BRNS. ONLY

70% HOT METAL
30% SCRAP

TOTAL 340 TONS

OPERATING DATA

Location 14

Open Hearth

Test No.	14-2	14-2	14-2	14-2	14-2
Date	11-18-76	11-18-76	11-18-76	11-18-76	11-18-76
Time	12:45	13:15	13:45	14:15	14:45
Gas Flow (cfh x 1000)	92	92	52	53	53
Furn. Press., in. H_2O	+1.0	+1.05	+.7	+.9	+.95
Air Flow, (cfm) x 10^3	24-26	28-31	19-21	20-22	20-22
Oxygen Flow, (cfh) x 10^3	33	35	0	40	36
Oxygen Flow integr.	8437.5	8438.2	8439.0	8440	8440.4
Atom. Steam Flow, lb/hr	—	—	—	—	—
Atom. Steam integr.	3575.2	3575.2	3575.2	3575.3	3575.3
Atom. Steam, lb/gal setpoint	2.5	2.5	2.5	3.3	3.3
Gas Flow, % of total Btu	60	60	60	60	60
Total Btu/hr x 10^6	157	157	103	108	104
Oil Flow, GPH	420	420	310	340	315
Total Btu integr.	1836.5	1839	1841.2	1843.5	1845.5
Checker Temp., °F	1620-1840	1500-1880	1550-1750	1500-1720	1520-1840
Bath Temp., °F	—	—	—	—	—
Oil Press., psig	35	35	35	35	45
Oil Flow integr.	271530	271702	271861	272026	272182
~~O_2 at North Bridgewall~~					
~~CO at North Bridgewall~~	SASS TEST	SASS TEST	SASS TEST	SASS TEST	SASS TEST
~~Time of Measurements at North Bridgewall~~					

Comments: START CHARGE OF SCRAP 12:45
FINISHED " " " 13:45
START CHARGING OF HOT METAL 15:05
FINISH " " " " 15:35

TOTAL 375 TONS
48% HOT METAL, 52% SCRAP

OPERATING DATA

Location 14

Open Hearth

Test No.	14-2	14-2	14-2	14-2	
Date	11-18-76	11-18-76	11-18-76	11-18-76	
Time	15:15	15:45	16:15	16:45	
Gas Flow (cfh x 1000)	93	93	87	86	
Furn. Press., in. H_2O	+1.05	1.05	1.1	.5	
Air Flow, (cfm) x 10^3	28.5-30	29-30	27-29	5	
Oxygen Flow, (cfh) x 10^3	38	83	80	82	
Oxygen Flow integr.	8441.3	8442.2	8444.5	8446.7	
Atom. Steam Flow, lb/hr	—	—	—	—	
Atom. Steam integr.	3575.7	3576.7	3578.1	3580	
Atom. Steam, lb/gal setpoint	8.0	7.9	8:1	8.5	
Gas Flow, % of total Btu	60	60	60	60	
Total Btu/hr x 10^6	158	158	150	147	
Oil Flow, GPH	420	420	405	400	
Total Btu integr.	1847.6	1850	1852.8	1855.6	
Checker Temp., °F	1600-1990	1700-1950	1740-2150	2050-2300	
Bath Temp., °F	—	—	2530@16:10	2670@16:40	
Oil Press., psig	100	105	100	100	
Oil Flow integr.	272338	272489	272684	272872	
~~O_2 at North Bridgewall~~					
~~CO at North Bridgewall~~		SASS TEST	SASS TEST		
~~Time of Measurements at North Bridgewall~~					

Comments: START OXYGEN LANCE 15:35

FINISH " " ?

OPERATING DATA

Location 14

Open Hearth

Test No.	14-3	14-3	14-3	14-3	14-3
Date	11-23-76	11-23-76	11-23-76	11-23-76	11-23-76
Time	12:30	13:00	13:30	14:00	15:00
Gas Flow (cfh x 1000)	75	97	96	77	80
Furn. Press., in. H_2O	+1.15	+1.1	+1.1	+1.1	+1.15
Air Flow, (cfm) x 10^3	26-28	27.5-30	28-30	25-28	26-28.5
Oxygen Flow, (cfh) x 10^3	46	56	54	76	77
Oxygen Flow integr.	8657.5	8658.5	8659.8	8661.5	8663.3
Atom. Steam Flow, lb/hr	—	—	—	—	—
Atom. Steam integr.	3685.5	3685.7	3686.4	3687.1	3687.7
Atom. Steam, lb/gal setpoint				5.0	5.0
Gas Flow, % of total Btu	60	60	60	60	50
Total Btu/hr x 10^6	130	164	162	131	155
Oil Flow, GPH	355	400	400	355	500
Total Btu integr.	2331.1	2333.4	2336.0	2338.4	2340.6
Checker Temp., °F	1550-1850	1570-1850	1600-1950	1560-1920	1550-1940
Bath Temp., °F	—	—	—	2500 @ 14:40	2560 @ 14:20
Oil Press., psig	50	75	75	80	90
Oil Flow integr.	307140	307285	307459	307618	307775
O_2 at North Bridgewall					
CO at North Bridgewall					
Time of Measurements at North Bridgewall					

Comments:

START CHARGING SCRAP 10:00
FINISH 11:00
START CHARGING HOT METAL 12:15
FINISH 12:50
TOTAL 375 TONS
48% HOT METAL
52% SCRAP

PARTIC. TEST CHARGING HOT METAL OXYGEN LANCING RETM. CHARGES.

PARTIC. TEST OXYG. LANCING

PARTIC. TEST OXYG. LANCING

PARTIC. TEST

OPERATING DATA

Location 14

Open Hearth

Test No.	14-3				
Date	11-23-76				
Time	15:00				
Gas Flow (cfh x 1000)	62				
Furn. Press., in. H_2O	+1.0				
Air Flow, (cfm) x 10^3	23-25				
Oxygen Flow, (cfh) x 10^3	80				
Oxygen Flow integr.	8665.5				
Atom. Steam Flow, lb/hr	—				
Atom. Steam integr.	3688.8				
Atom. Steam, lb/gal setpoint	7.0				
Gas Flow, % of total Btu	50				
Total Btu/hr x 10^6	125				
Oil Flow, GPH	400				
Total Btu integr.	2343.4				
Checker Temp., °F	1700-2040				
Bath Temp., °F	2660@14:50				
Oil Press., psig	90				
Oil Flow integr.	308000				
O_2 at North Bridgewall					
CO at North Bridgewall					
Time of Measurements at North Bridgewall					

Comments:

BRINK

OPERATING DATA

Location 14

Open Hearth

Test No.	BASELINE →				
Date	3-29-77	3-29-77	3-29-77	3-29-77	3-29-77
Time	10:00	10:30	11:00	11:30	12:00
Gas Flow (cfh x 1000)	68	86	86	85	86
Furn. Press., in. H_2O	+.11	+.09	+.095	+.095	+0.115
Air Flow, (cfm) x 10^3	21	29	30	30	30
Oxygen Flow, (cfh) x 10^3	44	44	0	67	60
Oxygen Flow integr.	1955.3	1956.4	1957.5	1958.8	1960.6
Atom. Steam Flow, lb/hr	1550	1800	1900	1900	3700
Atom. Steam integr.	7880.9	7881.6	7882.6	7883.5	7885
Atom. Steam, lb/gal setpoint	4.8	4.8	4.8	4.8	6.0
Gas Flow, % of total Btu	58	58	58	58	58
Total Btu/hr x 10^6	122	140	142	142	143
Oil Flow, GPH	350	390	380	370	370
Total Btu integr.	9124.7	9126.0	9128.8	9131	9134.2
Checker Temp., °F	1960	1970	2040	2010	2100
Bath Temp., °F	—	—	—	—	2630
Oil Press., psig	35	55	67	63	110
Oil Flow integr.	977978	978071	978249	978400	978616
O_2 at North Bridgewall %		7.0			
CO at North Bridgewall %		0			
Time of Measurements at North Bridgewall					

Comments: TOTAL HEAT 377 TONS (30% HOT METAL) SCRAP 416,000 #
COLD IRON 113,000 #
HOT METAL 221,000 #

START CHARGING SCRAP 7:00
FINISH CHARGING SCRAP 8:15
10:20 NO FIRE. LEAK IN WATER COOLING HOSE ON #4 DOOR. DOORS CLOSED.
10:27 RESUME FIRE. LEAK FIXED.
10:40 AIR WAS SHUT OFF, FIRE ON, OXYGEN LANCES ON. 0% O_2, 2.5% CO OVER BRIDGEWALL. ALL READINGS FROM NORTH SIDE.
10:43 AIR FLOW WAS REDUCED TO 23 CFM. 15% O_2. NO CO.
10:46 NORMAL AIRFLOW
10:48 START CHARGING HOT METAL
11:10 O_2 = 2% OVER NORTH BRIDGEWALL. 0% CO (WITH OXYG. LANCING)

11:15 FINISHED CHARGING HOT METAL
11:50 3% O_2. 0% CO ON SOUTH SIDE. FIRING FROM NORTH SIDE.

OPERATING DATA

Location 14

Open Hearth

Test No.	BASELINE	→			→
Date	3-29-77	3-29-77	3-29-77	3-29-77	3-29-77
Time	12:30	13:00	13:30	14:00	14:30
Gas Flow (cfh x 1000)	86	0	81	95	91
Furn. Press., in. H_2O	+.115	.115	.13	.135	+.105
Air Flow, (cfm) x 10^3	30	29.5	36	35.5	26
Oxygen Flow, (cfh) x 10^3	78	106	104	107	0
Oxygen Flow integr.	1961.9	1964.6	1966.9	1970	1970.3
Atom. Steam Flow, lb/hr	3650	4200	4500	2500	2500
Atom. Steam integr.	7886.4	7889	7890.8	7892.4	7893.7
Atom. Steam, lb/gal setpoint	6.0	7.4	7.4	4.3	5.5
Gas Flow, % of total Btu	58	58	58	50	60
Total Btu/hr x 10^6	144	34	136	168	150
Oil Flow, GPH	380	330	360	480	380
Total Btu integr.	9136	9137.3	9138.9	9142.0	9144.1
Checker Temp., °F	2150	2070	2090	2120	2010
Bath Temp., °F	—	2710	2810	2855	—
Oil Press., psig	105	104	114	89	84
Oil Flow integr.	978742	978835	978955	979188	979349
O_2 at SOUTH Bridgewall		9.0	2.0	—	
CO at North Bridgewal.					
Time of Measurements at North Bridgewall					

Comments: 12:33 GAS FUEL ONLY
12:36 NO FIRE
12:40 GAS FIRE BACK ON
14:15 TAP
14:21 FIRE OFF
14:40 START COATING FURNACE WITH DOLOMITE. NO FIRE.

OPERATING DATA

Location 14

Open Hearth

Test No.	BASELINE				→
Date	3-29-77	3-29-77	3-29-77	3-29-77	3-29-77
Time	15:00	15:30	16:00	16:30	17:00
Gas Flow (cfh x 1000)	0	54	53	100	72
Furn. Press., in. H_2O	-.05	+.092	+.09	+.09	+.11
Air Flow, (cfm) x 10^3	0	26	26.5	25	24
Oxygen Flow, (cfh) x 10^3	0	31	32	39	57
Oxygen Flow integr.	1970.3	1970.3	1971	1971.9	1973.2
Atom. Steam Flow, lb/hr	1500	1700	1800	2000	2000
Atom. Steam integr.	7895.2	7896.3	7897.2	7898.4	7900.4
Atom. Steam, lb/gal setpoint	5.5	7.0	7.0	5.9	5.8
Gas Flow, % of total Btu	60	60	60	60	60
Total Btu/hr x 10^6	—	97	98	122	123
Oil Flow, GPH	0	280	285	330	330
Total Btu integr.	9145	9147	9148.8	9151.2	9153.3
Checker Temp., °F	1900	1850	1930	1930	1970
Bath Temp., °F	—	—	—	—	—
Oil Press., psig	—	47	60	71	74
Oil Flow integr.	979404	979553	979682	979859	980012
O_2 at North Bridgewall					
CO at North Bridgewall					
Time of Measurements at North Bridgewall					

Comments: 15:01 FINISHED COATING FURNACE
15:04 OIL + GAS FIRE ON
15:07 3 DOORS OPEN. START CHARGING SCRAP. LOW FIRE.
15:20 ROOF BURNERS ON
16:09 STOP CHARGING SCRAP. DOORS CLOSED
TOTAL CHARGE 387 TONS. 30% HOT METAL.
16:16 START BANKING DOORS. LOW FIRE.
16:21 FINISH BANKING DOORS. HI FIRE.

OPERATING DATA

Location 14

Open Hearth

Test No.	BASELINE				
Date	3-29-77				
Time	17:30				
Gas Flow (cfh x 1000)	63				
Furn. Press., in. H_2O	+.09				
Air Flow, (cfm) x 10^3	24				
Oxygen Flow, (cfh) x 10^3	57				
Oxygen Flow integr.	1974.3				
Atom. Steam Flow, lb/hr	2000				
Atom. Steam integr.	7900.3				
Atom. Steam, lb/gal setpoint	5.8				
Gas Flow, % of total Btu	60				
Total Btu/hr x 10^6	121				
Oil Flow, GPH	320				
Total Btu integr.	9155.2				
Checker Temp., °F	1980				
Bath Temp., °F	—				
Oil Press., psig	70				
Oil Flow integr.	980146				
O_2 at North Bridgewall					
CO at North Bridgewall					
Time of Measurements at North Bridgewall					

Comments: HOT METAL WILL BE CHARGED AT 18:00

OPERATING DATA

Location 14

Open Hearth

Test No.	LOW O_2	—			→
Date	3-30-77	3-30-77	3-30-77	3-30-77	3-30-77
Time	9:00	9:30	10:00	10:30	11:00
Gas Flow (cfh x 1000)	71	89	0	73	0
Furn. Press., in. H_2O	+.12	+.115	+.095	+.11	+.02
Air Flow, (cfm) x 10^3	29	30	23	25	0
Oxygen Flow, (cfh) x 10^3	56	69	144	0	0
Oxygen Flow integr.	2013.6	2015.3	2018.2	2019	2019
Atom. Steam Flow, lb/hr	35	41	25	37	15
Atom. Steam integr.	7940.2	7942.9	7945.1	7946.8	7948.2
Atom. Steam, lb/gal setpoint	7.1	6.4	6	7	7
Gas Flow, % of total Btu	60	60	60	60	60
Total Btu/hr x 10^6	120	144	82	123	140
Oil Flow, GPH	335	380	0	330	0
Total Btu integr.	9221.2	9223.6	9225	9226.6	9228
Checker Temp., °F	2060	2150	2100	1950	1850
Bath Temp., °F	—	2780	2895	—	—
Oil Press., psig	111	125	220	108	220
Oil Flow integr.	984625	984801	984902	985024	985118
O_2 at North Bridgewall, %	0	TRACE	6.5	10	NO FIRE
CO at North Bridgewall, %	4.0	4.5	FUEL OFF	0	
Time of Measurements at North Bridgewall	9:10	9:40	10:12	10:40 DOORS OPEN	

Comments: TOTAL HEAT 755,000 # 30% HOT METAL
4:15 START LOADING SCRAP
5:30 FINISH LOADING SCRAP
7:30 START LOADING HOT METAL
8:00 FINISH " " "
10:15 TAP. FIRE ON TO KEEP FURNACE HOT.
5% O_2; 0% CO
10:35 START MAKING UP FURNACE WITH DOLOMITE. DOORS OPEN.
LOW FIRE.
10:45 NO FIRE.

11:06 FIRE ON (OIL ONLY)
11:10 FINISHED MAKING UP FURNACE.
11:15 STARTED CHARGING SCRAP (DOORS OPEN)

OPERATING DATA

Location 14

Open Hearth

Test No.	LOW O_2	→	→	→	→
Date	3-30-77	3-30-77	3-30-77	3-30-77	3-30-77
Time	11:30	12:00	12:30	13:00	13:30
Gas Flow (cfh x 1000)	111	111	56	57	73
Furn. Press., in. H_2O	+.12	+0.11	+.11	+.12	+.12
Air Flow, (cfm) x 10^3	36.5	36.5	25	24	26
Oxygen Flow, (cfh) x 10^3	49	0	0	38	40
Oxygen Flow integr.	2020.4	2020.2	2020.5	2021	2022.0
Atom. Steam Flow, lb/hr	48	51	29	29	23
Atom. Steam integr.	7950.4	7953	7954.7	7956.2	7957.9
Atom. Steam, lb/gal setpoint	7.4	6.5	7.5	7.5	5.9
Gas Flow, % of total Btu	60	60	60	60	60
Total Btu/hr x 10^6	173	175	102	102	124
Oil Flow, GPH	430	440	300	280	340
Total Btu integr.	9230.3	9233.2	9235.2	9236.9	9239.2
Checker Temp., °F	1850	1900	1930	1980	2000
Bath Temp., °F	—	—	—	—	—
Oil Press., psig	130	140	92	92	81
Oil Flow integr.	98529.	985472	985624	985758	985924
O_2 at North Bridgewall %				1.25	TRACE
CO at North Bridgewall %				TRACE	1
Time of Measurements at North Bridgewall				12:55	13:35

Comments:

DOORS OPEN

12:02 ROOF BURNERS ON (3 ZONES)

12:37 FINISHED CHARGING SCRAP. ROOF BURNERS OFF. DOORS CLOSED.

12:45 START BANKING DOORS, LOW AIRFLOW (15000 CFM) (.05 FURN. PRESS.)

12:52 FINISHED BANKING DOORS. ROOF BURNERS ON. DOORS CLOSED.

TOTAL HEAT 735,000 # 30% HOT METAL

13:10 1% O_2, 1% CO ON NORTH BRIDGEWALL

NOTE: BURNERS FIRE 10 MIN. ON SOUTH SIDE AND 10 MIN. ON NORTH SIDE. BETWEEN SWITCHING FURNACE IS PURGED WITH AIR FROM FD FAN. IF NECESSARY THE SWITCHING CYCLE IS CHANGED TO 7 OR 8 MIN ON EACH SIDE.

OPERATING DATA

Location 14

Open Hearth

Test No.	LOW O_2	———	———	——→	
Date	3-30-77	3-30-77	3-30-77	3-30-77	
Time	14:00	14:30	15:00	15:30	
Gas Flow (cfh x 1000)	93	69	90	94	
Furn. Press., in. H_2O	+.12	+.105	+.09	+.11	
Air Flow, (cfm) x 10^3	29	26	36	35	
Oxygen Flow, (cfh) x 10^3	57	58	58	58	
Oxygen Flow integr.	2022.9	2024.1	2025.7	2026.5	
Atom. Steam Flow, lb/hr	29	35	15	15	
Atom. Steam integr.	7960.3	7960.8	7962.5	7963.1	
Atom. Steam, lb/gal setpoint	5.5	6.8	4.8	4.8	
Gas Flow, % of total Btu	60	60	60	60	
Total Btu/hr x 10^6	150	121	146	150	
Oil Flow, GPH	370	340	370	370	
Total Btu integr.	9241.6	9244	9247.1	9248.7	
Checker Temp., °F	2050	2250	2100	2120	
Bath Temp., °F	—	—	—	—	
Oil Press., psig	95	99	27	39	
Oil Flow integr.	986069	986256	986464	986566	
O_2 at North Bridgewall %	1	0	0	TRACE	
CO at North Bridgewall %	TRACE	4.5	2.5	2	
Time of Measurements at North Bridgewall	14:12	14:25	14:40	15:05	

Comments: 14:00 ROOF BURNERS OFF
14:10 START CHARGING HOT METAL
14:20 FINISHED CHARGING HOT METAL. OXYGEN LANCES O.V.
15:15 AIR WAS INCREASED TEMPORARILY TO 39,000. O_2=1.5% CO=1%
15:16 OXYGEN LANCE OFF. 2 DOORS OPEN TO ADD ADDITIVES.
15:19 OXYGEN LANCE ON. DOORS CLOSED
15:25 TRACE O_2 ; 2% CO

LOCATION 14

Fuel Gas Chromatographic Analysis

Nitrogen	35.2% (by volume)
Oxygen	8.54
Carbon Dioxide	0.42
Carbon Monoxide	< 0.05
Hydrogen	< 0.1
Methane	54.4
Ethane	1.22
Propane	0.15
C 4	0.056
C 5	0.034
C 6	0.015
Heating Value (calculated)	580 BTU dry/SCF

LOCATION 14

Fuel Oil Analysis

Carbon, %	85.62
Hydrogen, %	11.60
Nitrogen, %	0.29
Sulfur, %	1.06
Ash, %	0.045
Oxygen (by difference), %	1.39
API Gravity at 60°F	17.4
Gross Heat of Combustion, BTU/lb	18,640
Net Heat of Combustion, BTU/lb	17,580

PARTICULATE EMISSION CALCULATIONS

Test No. 14-3 Date 11-23-76 Location 14 Engr. _____

Unit No. 43 Fuel OIL/GAS Sampling Train and Method _____

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} 30.75 in. Hg

Tot. Liquid Collected, V_{lc} 66.9 ml Total Particulate, M_n 4492.3 m gm

Velocity Head, ΔP 0.38 iwg Stack Temp., Ts 897 °R Stack Area, As 70.9 ft^2

Sample Volume, Vm 60.0 ft^3 Stack Press., Psg -5.5 iwg Excess O_2, XO_2% 14.9 %

Orifice Press. Diff., H 0.42 iwg Stack Gas Sp. Gravity, Gs 1.02 n.d.

Sample Time, θ 120 min Nozzle Dia., Dn 0.25 in. Meter Temp., T_m _____ °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	61.68	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	3.17	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	0.049	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	1.1216	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	160.6×10^{-6}	lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	2.572	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	412.7	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	2622	ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	111.379	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	105.921	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	1020.6	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	348.3	N.D.
10. Emission	a. E = Eq. 4b x Fs x Eq. 9	5.02	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	2157	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	100.9	%

	Oil	Gas	Coal
Fs SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

89.74

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

TS+O

~~PARTICULATE EMISSION~~ CALCULATIONS

Test No. 14-2 Date 11-18-76 Location 14 OPEN HEARTH Engr. _____

Unit No. _____ Fuel OIL + NG Sampling Train and Method _____

Pitot Factor, Fs 0.83 Barometric Pressure, P_{bar} 30.34 in. Hg

Tot. Liquid Collected, V_{lc} 662 ml Total Particulate, M_n 20296 m gm

Velocity Head, ΔP .385 iwg Stack Temp., Ts 970 °R Stack Area, As 70.9 ft^2

Sample Volume, Vm 412.912 ft^3 Stack Press., Psg -5.5 iwg Excess O_2, XO_2 % 13.9 %

Orifice Press. Diff., H 3.4 iwg Stack Gas Sp. Gravity, Gs 1.02 n.d.

Sample Time, θ 164.7 min Nozzle Dia., Dn 9/16 in. Meter Temp., T_m 534 °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	421.89 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	31.38 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	0.069 N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	0.741 grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	106×10^{-6} lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	1.6991 grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	407.12 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	2763 ft/min
7. Stack Gas Flow Rate @ 70°F	a. Qsw = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	107067 WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	99680 DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	634.4 lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	298.6 N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	2.84 lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	1221 ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	105.6 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

89.74

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated. Data Sheet 6002-4

PARTICULATE CALCULATION SHEET

Test No. 14-1 Date 19-NOV-76 Location 14 Test Crew _____

Box No. _____ Sample Probe Position _____

Test Description BASELINE PARTICULATES

Dry Gas Meter Vol. (ft^3)

Final _____

Initial _____

Total _____

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final	140	114		686.4	940.4
Initial	100	100	0	673.5	873.5
Δ Vol	40	14	0	12.9	66.9

Beaker No.		1	3	4	5	6	Filter No. 12	Blank No. 13
Date Weighed		18 NOV 76	—	—	—	—	—	→
Tare Wt.	1	100.0984	101.9874	99.2677	98.9342	100.4855	.8026	.8538
	2	100.0984	101.9873	99.2677	98.9342	100.4855	.8026	.8536
	3	✓	101.9875	✓	✓	✓	✓	.8530 ✓
	4		✓					
	5							
	6							
Avg		100.0984	101.9874	99.2677	98.9342	100.4855	.8026	.8530

Bottle No.		1	2	3	4			
Content		Impinger (Water)	Probe (Acetone)	Probe (Water)	Cyclone (Acetone)	Flask (Dry)		
Rinse (ml)		400	500	200	400			
Date Weighed or 250 Bake			29 NOV 76	—	—	—	—	→
Final Wt. 250	1	100.1393	102.4437	99.2875	99.1516	102.3257	2.7450	.8538
	2	100.1393	102.4437	99.2875	99.1516	102.3257	2.7449	.8538
	3	✓	✓	✓	✓	✓	✓	✓
	4							
	5							
	6							
Avg		100.1393	102.4437	99.2875	99.1516	102.3257	2.7449	.8538
Residue wt Final 250-Tare		.0409	0.4563	.0198	0.2174	1.8402	1.9423	.0008
Date Weighed or 650 Bake		29 NOV 76	CYL-H_2O PRE 7	CYL-H_2O POST 7	H_2O BLANK PRE 8	H_2O BLANK POST 8		
Final Wt. 650	1		104.0062	104.0167	99.3371	99.3435		
	2		104.0062	104.0167	99.3372	99.3438		
	3		✓	✓	99.3372 ✓	✓		
	4							
	5							
	6							
Avg			104.0062	104.0167	99.3372	99.3438		
Residue Wt Final 650-Tare		BOTTLE 5 →	125	.0105		.0066		

Comments: @ 100 mg

Data Sheet 6002-3

PLANT
LOCATION 14
OPERATOR
DATE 11/22/76
RUN NO. 14-1
SAMPLE BOX NO. 1
METER BOX NO. 1
METER H
C FACTOR @ .83

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 32 °F
BAROMETRIC PRESSURE
ASSUMED MOISTURE, %
HEATER BOX SETTING
PROBE LENGTH, IN. 48
NOZZLE DIAMETER, IN. 1/4
PROBE HEATER SETTING

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time ~~to~~ Min. CLOCK TIME	Static Pressure (P_s), In. ~~Hg~~ H_2O	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume METER READING (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter: Inlet ($T_{min.}$) °F	Gas Sample Temperature at Dry Gas Meter: Outlet (T_{mout}) °F	Sample Box Temprtature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
	1226	-5.5	440	.38	.42	1750.57		40	300	40
	1241		440	.38	.42	1759.00		45	300	40
	1256		438	.38	.42	1766.50		50	305	47
	1311		438	.38	.42	1774.00		58	305	44
	1326		425	.38	.42	1781.00		60	305	42
	1341		430	.38	.42	1789.00		62	300	41
	1356		440	.38	.42	1796.00		65	300	41
	1411		435	.38	.42	1803.00		68	305	41
	1426	↓	450	.38	.42	1810.57		68	305	40
TOTAL										
AVERAGE								AVG.	AVG.	

797

Test No. 14-3

CASCADE IMPACTOR DATA SHEET

TEST RUN NO. 14-3 LOCATION 14 DATE Nov. 22, 1976

IMPACTOR NO. 1 CYCLONE NO. 1 OPERATOR R. PIONESSA

SAMPLE POINT LOCATION DUCT

SUBSTRATE COATING NONE FUEL NG + OIL TEST LOAD _____ klb/hr

IMPACTOR ORIENTATION HORIZ. FLOW THRU IMPACTOR 0.206 CFM

FLUE STATIC PRESSURE -5.5 inH_2O, VELOCITY 45.97 ft/sec

NOZZLE DIA. 4 mm IMPACTOR PRESSURE DROP _____ END TIME 1458

GAS METER END 1812.25 CF START TIME 1451

GAS METER START 1810.60 CF DURATION 7 min

GAS VOLUME 1.65 CF FLOW RATE 0.236 CFM

AMBIENT TEMPERATURE 32 °F PRESSURE 30.71 IN Hg. HUMIDITY — %

FLUE GAS MOLECULAR WT. 29.35, TEMP. 440 °F, DENSITY 0.723 g/cc, VISCOSITY ____ POISE

	Stage Number							Stage Blank
	1	2	3	4	5			
Foil + Sample, g	3.6599	3.2644	3.6604	3.2550	3.7566			
Unused Foil, g	3.6737	3.2600	3.6631	3.2475	3.7685			
Sample, g		.0044		.0075				
Correction for Blank, g								
Final Sample, g								

FILTER NO.	Sample	Blank
FILTER + SAMPLE, g	0.7764	
FILTER TARE, g	0.7784	
SAMPLE, g		
CORRECTION FOR BLANK, g		
FINAL SAMPLE, g		

FULL CONTAINER, g 0.4212

EMPTY CONTAINER, g 0.4175

CYCLONE CATCH, g 0.0037

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Data: _____ _____

Location: 14 _____

Unit: _____ _____

Test: 14-1 Personnel: _____

Fuel: _____ _____

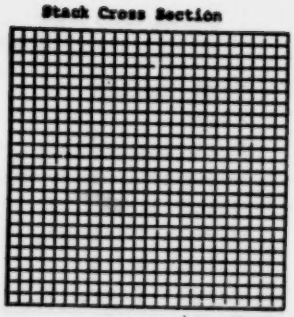
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): _____ (P_s)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O)	Gas Temp. (°F)	Gas Temp. (°R)	Molecular Wt.	Velocity (ft/sec)	O_2 Conc. (% Dry)
		in.	ΔP		T_s	M_s	V_s	
		12	.42	480				
		24	.42	↓				
		36	.39					
		48	.36					
		60	.35					
		72	.37	↓				
		AVG =	.385				45.8	

DUCT ϕ 9'-6"

6003-13

TRACE SPECIES AND ORGANICS SAMPLING CONDITIONS
OPEN HEARTH FURNACE - LOCATION 14

Test Number	14-2
Date	11-18-76
Port Location	ESP Inlet (sample point A)
Velocity, m/s (f/s)	13.96 (45.8)
Stack Temp., K (°F)	522 (480)
Oxygen Content, % dry	13.9
Moisture, %	6.9
Sample Time, min.	164.6
Cyclone Flow, awm^3/m (awcfm)	0.1226 (4.33)
Isokinetic Rate, %	106
Oven Temp., K (°F)	463 (373)
XAD-2 Temp., K (°F)	295 (71)
Meter Temp., K (°F)	294 (70)
Nozzle Size, mm (in.)	14.3 (0.562)
No. of Filters Used	2
Sample Flow, dry, $D\underline{N}m^3/m$ (scfm)	0.073 (2.56)
Volume Collected, dry, $D\underline{N}m^3$ (scf)	11.95 (421.9)
Particulate Collected, g	22.806
Solid Particulates, ng/J (lb/MMBtu)	1372 (3.19)
Unit Conditions	
Test Time, min.	230
Process Rate, tons/cycle	375
Hot Metal/Scrap, %/%	48/52
Fuel	Natural gas and No. 6 oil
Fuel Flow Rate, g/s (lb/hr)	402 (3200)
Stack Flow Rate, Nm^3/s (SCFM)	48.3 (102300)

KVB, Inc. Trace Species and Organics Sampling Data

Project: EPA PHASE III SASS Personnel: PINNESSA, MAGERTY, BUENING, HENNING Barometric Press: 30.34

Date: NOV. 18, 1976

Location: 14

Unit:

Test: 14-1

Fuel: NAT. GAS + OIL

Probe Nozzle Diameter (inches): (Dn)

Absolute Static Press. in Stack (in. Hg): (Ps)

Pitot Tube Coefficient: (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In/Out		
1247	0	3 ft. in	.38	3.4	391.588	10.0	504	409	40	34	379	36	36	
1302	15	"	.44	3.3	430.000	10.0	523	405	63	52	347	64	48	
1317	30	"	.44	3.3	467.000	11.0	502	406	62	52	365	59	55	
1332	45	"	.44	3.4	504.000	12.0	509	406	63	56	372	85	76	
1940	53	"	.50	4.2	524.000	16.0	516	414	82	72	375	84	76	
1347	60	"	.50	4.2	544.700	16.2	506	414	77	71	375	86	76	
1402	75	"	.50	4.2	586,000	16.5	496	414	81	67	378	88	77	
1408	81	"	.44	3.3	605.000	14.5	522	414	84	65	367	86	77	
1412	85.2	"			612.200	CHANGE DESSICANT								
1414	85.2	"	.44	3.3	612.200	14.8	500	414	84	65	377	80	77	
1429	105.0	"	.44	3.3	662.000	16.4	507	405	68	85	383	88	78	
1444	120	"	.44	3.3	698,000	17.5	510	403	74	80	385	87	79	
1451	127.3	"	.44	3.0	715.800	18.3	CHANGING FILTER							
1600	127.3	"	.44	3.3	715.800	9.0	517	402	68	52	365	79	76	
1630	157.3	"	.44	3.3	788.000	17.2	513	403	74	52	382	92	81	
1637	164.6	"	.41	2.6	804.500	18.5								

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 14 Date 11/18/76 Location 14 - OPEN HEARTH FURNACE

Sample Port Position UPSTREAM OF PRECIP

	Container Number		Sample Description	Container Type	Net wt/vol.	Comment	
	556	S	P+N+10μ SOLIDS	4 oz NAL	8.8596g	32.8829 DUP	
	574	S	3μ SOLIDS	"	2.0108g	25.6916	
	568	S	1μ SOLIDS	"	7.0748g	30.3604	
J#	290	S	#1 FILTER	PETRI	1.9166g	150.6936	
	441	S	#2 FILTER	PETRI	2.9445g	148.2069 / 148.2644	
K#	612	L	P+N+10μ WASH	16 oz A	304ml		
	613	L	"	"	414ml		
	614	L	3μ WASH	"	380ml		
	492	L	1μ WASH	8 oz A	115ml	1688ml	
	498	L	"	"	203ml		
	615	L	FILT. HOUR WASH	16 oz A	267ml		
	616	L	XAD MOD RINSE	16 oz A	430ml		
	532	S	XAD RESIN	16 oz AWM	147g	426-279	
L# 16 POM PCZ	268 ↑	L	XAD COND	1 l N	244ml		DUPLIC.
	671 L1	L	IMPINGER 1	"	501ml	1078-1135-240R	
	677 ↓	L	"	"	874ml		
	672	L	IMPINGER 2	"	619ml	1599-785-814 R	
	683	L	"	"	980ml		
	480	L	IMPINGER 3	8 oz N	116ml	1075-742-339R	
	687	L	"	1 l N	959ml		
	460	SB	FILTER BLANK	PETRI	?	145.1042	
	551	SB	XAD BLANK	4 oz N	38.4679g	62.0938	
	479	LB	IMP 2 & 3 BLANK	8 oz A	238ml		
	680	LB	H_2O BLANK	1 l N	1024ml		
	681	LB	50/50 BLANK	"	920ml		
	682	LB	IDA BLANK	"	931ml		
	678	LB	IMP #1 BLANK	"	770ml		
	1031	LF	#6 OIL FUEL	16 oz AWM	—		

COUNT S - 5, SB - 2, 7 SOLIDS; L - 3, LF - 1, LB - 5, 9 LIQUIDS; SD - 1 AA + EC, LD - 1 AA ONLY, 16 ANALYSES, 28 BOTTLES

Data Sheet KVB 6002-15

L1 EXCLUDE 672, 683, 480, 687 FOR SULF & NITRATES.

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 14 Date _____ Location 14 - OPEN HEARTH FURNACE

Sample Port Position UPSTREAM OF PRECIP.
SSMS FOR 14

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment
14A	556	S P+N+10 μ SOLIDS	4 oz NAL	8.8596g	39 %
	574	S 3 μ SOLIDS	"	2.0105g	9 %
	568	S 1 μ SOLIDS	"	7.0748g	31 %
	290 J	S #1 FILTER	PETRI	1.9166g	8 %
	461	S #2 FILTER	PETRI	2.9445g	13 %
				22.8060g	
14B	532	S XAD RESIN	16 oz AWM	147g	100 %
14C	616	L XAD MOD RINSE	16 oz A	430ml	9 %
	268	L XAD CONDENSATE	1 l N	244ml	5 %
	611	L IMP #1	"	501ml	11 %
	677 L	L "	"	874ml	19 %
	672	L IMP #2	"	619ml	13 %
	683	L "	"	980ml	21 %
	480	L IMP #3	8 oz A	116ml	2 %
	687	L "	"	959ml	20 %
				4713	
14D	1031	SF #6 OIL FUEL	16 oz AWM	—	100 %
14E	460	SB FILTER BLANK	PETRI	—	100 %
14F	479	LB IMP 2&3 BLANK	8 oz A	258ml	100 %
14G	681	LB 50/50 BLANK	1 l N	920ml	100 %
14H	682	LB IPA BLANK	"	931ml	100 %
14I	678	LB IMP #1 BLANK	"	770ml	100 %
	SSMS COUNT	S-2	L-1		9 SSMS ANALYSES
		SB-1	LB-4		
		SF-1	5		
		4 SOLIDS	LIQUIDS		
		+ 2 DUPLICATES			

Data Sheet KVB 6002-15

14-Open Hearth Furnace

Test 14 — TABLE Upstream of Precip.

POLLUTANT	SAMPLE NUMBER							
	556+	556+ dupl	574+	568+	J+	K*	616*	532+
Antimony	<50	<50	<100	<150	<150	<0.5	<0.5	<50
Arsenic	75	150	70	80	75	0.025	<0.010	<3
Barium	20	15	30	20	16	<0.05	<0.05	<2.5
Beryllium	<0.5	<0.5	<0.5	<0.5	<1.5	<0.005	<0.005	<0.5
Cadmium	130	130	280	280	550	0.11	0.046	<0.5
Calcium	30000	28000	49000	18000	27000	1.6	<0.05	3700
Chromium	320	320	380	330	310	0.21	5.3	2.5
Cobalt	<25	<25	<50	<25	<25	<0.05	0.15	<25
Copper	940	930	1500	1500	1730	0.52	0.05	0.5
Iron	240000	210000	340000	270000	270000	120	11.0	66.0
Lead	9500	9500	22000	12000	62000	9.1	<0.03	<5
Manganese	2200	2300	2700	2100	2300	1.2	0.43	5.5
Mercury	<0.5	<0.5	<0.6	<0.5	<0.7	<0.005	<0.005	<0.5
Nickel	130	120	150	130	130	0.10	7.0	1.5
Selenium	<5	<5	<10	<5	<16	<0.01	<0.01	5
Tellurium	50	50	250	380	730	<5	<5	<25
Tin	<250	<250	<500	<500	<800	<1	<1	<250
Titanium	500	500	1000	500	830	<1	<1	40
Vanadium	60	55	50	50	66	<0.1	<0.1	<5
Zinc	65000	55000	160000	130000	120000	2.0	0.055	3.5
Chloride	400	390	1750	1780	2.6	4.78	30.8	2.6
Fluoride						<0.20	22.0	
Nitrates	11.0	12.0	16.0	192	85.0	3.88	0.84	36.0
Sulfates	19000	18000	23000	28500	19000	5.0	3.0	100
					290, 461	612, 613, 614, 492, 498, 615		

14-Open Hearth Furnace

Test 14 — TABLE — Upstream of Precip.

POLLUTANT	SAMPLE NUMBER							
	L*	L* dupl	L_1*	460+	551+	479*	680*	681*
Antimony	0.5	0.5		—	<50	0.9	<0.5	<0.5
Arsenic	<0.010	<0.010		—	<3	<0.010	<0.010	<0.010
Barium	<0.05	<0.05		—	<2.5	<0.05	<0.05	<0.05
Beryllium	<0.005	<0.005		—	<0.5	<0.005	<0.005	<0.005
Cadmium	0.034	0.034		—	<0.5	0.030	0.010	<0.01
Calcium	1.0	0.80		—	3700	0.28	<0.05	<0.05
Chromium	4.4	4.3		—	3	<0.05	<0.05	<0.05
Cobalt	0.14	0.10		—	<25	<0.05	<0.05	<0.05
Copper	0.17	0.16		—	0.5	0.33	0.36	<0.01
Iron	27.0	26.0		—	51	0.20	<0.05	<0.05
Lead	<0.03	<0.03		—	<5	0.6	<0.03	<0.03
Manganese	0.17	0.16		—	5.5	<0.01	<0.01	<0.01
Mercury	<0.005	<0.005		0.1/paper	<0.5	<0.005	<0.005	<0.005
Nickel	4.4	4.2		—	<1	0.07	<0.05	<0.05
Selenium	<0.01	<0.01		—	<5	<0.01	<0.01	<0.01
Tellurium	<5	<5		—	<25	<5	<5	<5
Tin	<1	<1		—	<250	<1	<1	<1
Titanium	<1	<1		—	25	<1	<1	<1
Vanadium	<0.1	<0.1		—	<5	<0.1	<0.1	<0.1
Zinc	0.15	0.088		—	3	0.180	0.088	0.010
Chloride	7.40	8.00	—	(<800)	2.6	55.6	<0.3	2.12
Fluoride	38.5	41.0	—			17.4	1.55	1.90
Nitrates	5.36	5.44	2.76	<5	<1	<0.10	0.50	<0.10
Sulfates	17800	17200	1040	<800	<50	18300	<5	<5
	268, 671, 677, 672, 683, 480, 680		268, 671, 677					

no metals

14-Open Hearth Furnace

Test 14	TABLE Upstream of Precip.							
POLLUTANT	SAMPLE NUMBER							
	682*	678*	1031 †	1031 † Dup				
Antimony	<0.5	<0.5	<25	<25				
Arsenic	<0.010	<0.010	< 2	<2				
Barium	<0.05	<0.05	<5	<5				
Beryllium	<0.005	<0.005	<0.3	<0.3				
Cadmium	<0.01	<0.01	<0.3	<0.3				
Calcium	<0.05	0.10	34	28				
Chromium	<0.05	<0.05	<5	<5				
Cobalt	<0.05	<0.05	<10	<10				
Copper	<0.01	0.13	<3	<3				
Iron	<0.05	<0.05	38	40				
Lead	<0.03	<0.03	<3	<3				
Manganese	<0.005	<0.005	1.2	0.8				
Mercury	<0.005	<0.005	<0.1	<0.1				
Nickel	<0.01	<0.01	11	8.5				
Selenium	<0.01	<0.01	<1	<1				
Tellurium	<5	<5	<25	<25				
Tin	<1	<1	<25	<25				
Titanium	<1	<1	<250	<250				
Vanadium	<0.1	<0.1	30	35				
Zinc	<0.005	0.040	3	2				
Chloride	<0.3	<0.3	<17	—				
Fluoride	1.40	3.65	38	—				
Nitrates	<0.10	<0.10	—	—				
Sulfates	<5	<5	—	—				

COMMERCIAL TESTING & ENGINEERING CO.

Reply to GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 738-8484
INSTRUMENTAL ANALYSIS DIVISION, 14288 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9221

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: Test 14 A 556, 574, 568, 290, 461

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	17	Terbium	1	Ruthenium		Vanadium	220
Thorium	22	Gadolinium	3	Molybdenum	53	Titanium	MC
Bismuth	2	Europium	2	Niobium	27	Scandium	15
Lead	210	Samarium	6	Zirconium	100	Calcium	MC
Thallium	28	Neodymium	26	Yttrium	39	Potassium	MC
Mercury	NR	Praseodymium	12	Strontium	760	Chlorine	440
Gold		Cerium	91	Rubidium	200	Sulfur	MC
Platinum		Lanthanum	49	Bromine	45	Phosphorus	MC
Iridium		Barium	MC	Selenium	36	Silicon	MC
Osmium		Cesium	4	Arsenic	98	Aluminum	MC
Rhenium	≤0.1	Iodine	6	Germanium	66	Magnesium	MC
Tungsten	7	Tellurium	≤0.7	Gallium	78	Sodium	MC
Tantalum	≤0.8	Antimony	23	Zinc	MC	Fluorine	≈160
Hafnium	0.5	Tin	24	Copper	320	Oxygen	NR
Lutetium	0.3	Indium	STD	Nickel	110	Nitrogen	NR
Ytterbium	2	Cadmium	3	Cobalt	36	Carbon	NR
Thulium	0.4	Silver	5	Iron	MC	Boron	MC
Erbium	2	Palladium		Manganese	MC	Beryllium	0.8
Holmium	3	Rhodium		Chromium	540	Lithium	33
Dysprosium	5					Hydrogen	NR

NR – Not Reported
All elements not reported <0.1 ppm weight

Approved: M Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 788-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 14 B #1

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.3
Thorium		Gadolinium		Molybdenum	4	Titanium	16
Bismuth		Europium		Niobium		Scandium	≤0.09
Lead	≤1	Samarium		Zirconium	2	Calcium	110
Thallium		Neodymium		Yttrium	0.3	Potassium	480
Mercury	NR	Praseodymium		Strontium	2	Chlorine	3
Gold		Cerium		Rubidium	0.1	Sulfur	14
Platinum		Lanthanum		Bromine	1	Phosphorus	27
Iridium		Barium	5	Selenium	0.5	Silicon	800
Osmium		Cesium	≤0.1	Arsenic	≤0.3	Aluminum	120
Rhenium		Iodine		Germanium		Magnesium	15
Tungsten		Tellurium		Gallium	0.3	Sodium	99
Tantalum		Antimony		Zinc	5	Fluorine	≈3
Hafnium		Tin		Copper	2	Oxygen	NR
Lutetium		Indium	STD	Nickel	2	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.1	Carbon	NR
Thulium		Silver	12	Iron	67	Boron	7
Erbium		Palladium		Manganese	0.4	Beryllium	
Holmium		Rhodium		Chromium	9	Lithium	0.2
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.3 ppm weight

Approved: M Jacobs

Total sample was inadvertently ground in a coors mortar & pestle. See attached note.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 920 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 788-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

To: Mr. John Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 14 B #2

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	<0.1
Thorium		Gadolinium		Molybdenum	6	Titanium	1
Bismuth		Europium		Niobium	≤0.3	Scandium	≤0.1
Lead	≤1	Samarium		Zirconium	2	Calcium	100
Thallium		Neodymium		Yttrium		Potassium	22
Mercury	NR	Praseodymium	0.3	Strontium	0.4	Chlorine	0.9
Gold		Cerium	0.3	Rubidium	0.1	Sulfur	6
Platinum		Lanthanum	≤0.6	Bromine	≤0.6	Phosphorus	15
Iridium		Barium	2	Selenium	0.4	Silicon	37
Osmium		Cesium	≤0.1	Arsenic		Aluminum	5
Rhenium		Iodine	0.4	Germanium	≤0.2	Magnesium	12
Tungsten		Tellurium	≤0.7	Gallium	0.2	Sodium	69
Tantalum		Antimony		Zinc	14	Fluorine	≈9
Hafnium		Tin	0.8	Copper	4	Oxygen	NR
Lutetium		Indium	STD	Nickel	4	Nitrogen	NR
Ytterbium		Cadmium	≤0.4	Cobalt	≤0.1	Carbon	NR
Thulium		Silver	2	Iron	15	Boron	3
Erbium		Palladium		Manganese	0.3	Beryllium	
Holmium		Rhodium		Chromium	7	Lithium	<0.1
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.3 ppm weight

Approved: M Y Jacobs

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucible prior to analysis.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 788-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 14 C 616, 268, 671, 677, 672, 683, 480, 687

IAD No.: 97-A197-134-31

CONCENTRATION IN ug/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.9	Titanium	0.04
Bismuth		Europium		Niobium		Scandium	<0.001
Lead	≤0.02	Samarium		Zirconium	0.03	Calcium	6
Thallium		Neodymium		Yttrium		Potassium	5
Mercury	NR	Praseodymium		Strontium	0.02	Chlorine	0.3
Gold		Cerium		Rubidium		Sulfur	MC
Platinum		Lanthanum		Bromine	0.08	Phosphorus	3
Iridium		Barium	0.09	Selenium	≤0.01	Silicon	1
Osmium		Cesium		Arsenic	≤0.002	Aluminum	0.1
Rhenium		Iodine	0.02	Germanium		Magnesium	0.2
Tungsten		Tellurium		Gallium	≤0.003	Sodium	3
Tantalum		Antimony		Zinc	~0.2	Fluorine	≈0.3
Hafnium		Tin		Copper	0.2	Oxygen	NR
Lutetium		Indium	STD	Nickel	6	Nitrogen	NR
Ytterbium		Cadmium	≤0.006	Cobalt	0.003	Carbon	NR
Thulium		Silver	MC	Iron	MC	Boron	0.03
Erbium		Palladium		Manganese	0.2	Beryllium	≤0.001
Holmium		Rhodium		Chromium	9	Lithium	0.005
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported < 0.003 ug/ml.

Approved: M Jacobs

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucit

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 999 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 799-0484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14235 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810
Sample No.: 14 D #1 1031

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	16
Thorium		Gadolinium		Molybdenum	7	Titanium	1
Bismuth		Europium		Niobium		Scandium	0.3
Lead	1	Samarium		Zirconium	2	Calcium	40
Thallium		Neodymium		Yttrium		Potassium	22
Mercury	NR	Praseodymium		Strontium	0.4	Chlorine	4
Gold		Cerium		Rubidium		Sulfur	160
Platinum		Lanthanum		Bromine	0.9	Phosphorus	5
Iridium		Barium	1	Selenium	≤1	Silicon	**72
Osmium		Cesium		Arsenic	0.1	Aluminum	**4
Rhenium		Iodine		Germanium		Magnesium	8
Tungsten		Tellurium		Gallium	≤0.2	Sodium	13
Tantalum		Antimony		Zinc	2	Fluorine	≈2
Hafnium		Tin		Copper	1	Oxygen	NR
Lutetium		Indium	STD	Nickel	10	Nitrogen	NR
Ytterbium		Cadmium	≤0.4	Cobalt	≤0.1	Carbon	NR
Thulium		Silver	≤0.3	Iron	**49	Boron	2
Erbium		Palladium		Manganese	0.3	Beryllium	
Holmium		Rhodium		Chromium	0.6	Lithium	0.4
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.3ppm weight

Approved: M Jacobs

**Heterogeneous -Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucible prior to analysis.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 999 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 738-8484

Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 23, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 14 D #2 1031

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	17
Thorium		Gadolinium		Molybdenum	6	Titanium	1
Bismuth		Europium		Niobium		Scandium	≤0.1
Lead	≤0.7	Samarium		Zirconium	1	Calcium	28
Thallium		Neodymium		Yttrium		Potassium	14
Mercury	NR	Praseodymium		Strontium	0.3	Chlorine	3
Gold		Cerium		Rubidium		Sulfur	MC
Platinum		Lanthanum		Bromine		Phosphorus	6
Iridium		Barium	0.7	Selenium	≤0.5	Silicon	46
Osmium		Cesium		Arsenic	≤0.1	Aluminum	0.8
Rhenium		Iodine		Germanium		Magnesium	6
Tungsten		Tellurium		Gallium	≤0.1	Sodium	53
Tantalum		Antimony		Zinc	2	Fluorine	≈26
Hafnium		Tin		Copper	1	Oxygen	NR
Lutetium		Indium	STD	Nickel	7	Nitrogen	NR
Ytterbium		Cadmium	≤0.3	Cobalt	0.05	Carbon	NR
Thulium		Silver	0.2	Iron	9	Boron	4
Erbium		Palladium		Manganese	0.4	Beryllium	
Holmium		Rhodium		Chromium	0.5	Lithium	0.2
Dysprosium						Hydrogen	NR

NR – Not Reported

All elements not reported <0.2 ppm weight

Approved: M Yacobs

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucibl prior to analysis.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 230 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14235 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9321

To: Mr. John Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, New York
14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 14 E 460

IAD No.: 97-A197-134-31

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.8	Terbium		Ruthenium		Vanadium	<0.1
Thorium		Gadolinium		Molybdenum	1	Titanium	3
Bismuth		Europium		Niobium		Scandium	0.3
Lead	1	Samarium		Zirconium	0.8	Calcium	MC
Thallium		Neodymium	0.3	Yttrium		Potassium	490
Mercury	NR	Praseodymium	0.1	Strontium	1	Chlorine	MC
Gold		Cerium	0.2	Rubidium	0.3	Sulfur	7
Platinum		Lanthanum	0.3	Bromine	0.8	Phosphorus	51
Iridium		Barium	3	Selenium	0.5	Silicon	820
Osmium		Cesium	<0.1	Arsenic	1	Aluminum	>120
Rhenium		Iodine	0.4	Germanium		Magnesium	220
Tungsten		Tellurium	≤0.3	Gallium	0.4	Sodium	>300
Tantalum		Antimony		Zinc	3	Fluorine	~17
Hafnium		Tin	3	Copper	4	Oxygen	NR
Lutetium		Indium	STD	Nickel	2	Nitrogen	NR
Ytterbium		Cadmium	≤0.3	Cobalt	0.4	Carbon	NR
Thulium		Silver	0.4	Iron	10	Boron	9
Erbium		Palladium		Manganese	0.2	Beryllium	
Holmium		Rhodium		Chromium	0.6	Lithium	0.3
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.1ppm weight

Approved:

Total weight of filter was 0.3212 g as received. A 0.2947 g portion was acid leached in ultra pure nitric hydrochloric acid shows, rinsed then all resulting filtrate was analyzed.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 920 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 799-0424
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14235 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 14 F 479

IAD No.: 97-A197-134-31

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.03	Terbium		Ruthenium		Vanadium	0.001
Thorium		Gadolinium		Molybdenum	0.2	Titanium	0.03
Bismuth	≤0.007	Europium		Niobium		Scandium	≤0.002
Lead	0.03	Samarium		Zirconium	0.06	Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	6
Mercury	NR	Praseodymium		Strontium	0.04	Chlorine	0.2
Gold		Cerium		Rubidium		Sulfur	MC
Platinum		Lanthanum		Bromine	0.01	Phosphorus	2
Iridium		Barium	0.1	Selenium	≤0.02	Silicon	0.3
Osmium		Cesium	≤0.002	Arsenic	≤0.003	Aluminum	0.4
Rhenium		Iodine	0.005	Germanium		Magnesium	1
Tungsten		Tellurium		Gallium	≤0.003	Sodium	MC
Tantalum		Antimony		Zinc	1	Fluorine	≈0.03
Hafnium		Tin	≤0.01	Copper	0.4	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.04	Nitrogen	NR
Ytterbium		Cadmium	≤0.007	Cobalt	≤0.001	Carbon	NR
Thulium		Silver	MC	Iron	0.2	Boron	0.01
Erbium		Palladium		Manganese	0.009	Beryllium	
Holmium		Rhodium		Chromium	0.02	Lithium	0.05
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.004 µg/ml

Approved: M L Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

Reply to GENERAL OFFICES: 230 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484
INSTRUMENTAL ANALYSIS DIVISION, 14238 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9621

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810
Sample No.: KVB 14 G 681

IAD No.: 97-A197-134-31

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	≤0.001
Thorium		Gadolinium		Molybdenum	0.2	Titanium	0.02
Bismuth		Europium		Niobium		Scandium	<0.001
Lead	≤0.02	Samarium		Zirconium	0.05	Calcium	9
Thallium		Neodymium		Yttrium		Potassium	0.8
Mercury	NR	Praseodymium		Strontium	0.005	Chlorine	0.2
Gold		Cerium		Rubidium		Sulfur	0.4
Platinum		Lanthanum		Bromine		Phosphorus	0.2
Iridium		Barium	0.02	Selenium	≤0.02	Silicon	**4
Osmium		Cesium		Arsenic	≤0.003	Aluminum	0.01
Rhenium		Iodine	0.007	Germanium		Magnesium	0.2
Tungsten		Tellurium		Gallium	≤0.005	Sodium	0.3
Tantalum		Antimony		Zinc	0.09	Fluorine	≈0.2
Hafnium		Tin		Copper	0.006	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.006	Nitrogen	NR
Ytterbium		Cadmium	≤0.01	Cobalt	≤0.001	Carbon	NR
Thulium		Silver	0.009	Iron	0.2	Boron	0.06
Erbium		Palladium		Manganese	0.01	Beryllium	
Holmium		Rhodium		Chromium	0.007	Lithium	≤0.001
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.006 µg/ml
**Heterogeneous

Approved: M J Sanders

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 729-8484

Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, New York
14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 14 H 682

IAD No.: 97-A197-134-31

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.001
Thorium		Gadolinium		Molybdenum	0.1	Titanium	0.01
Bismuth		Europium		Niobium		Scandium	≤0.001
Lead	≤0.02	Samarium		Zirconium	0.06	Calcium	0.7
Thallium		Neodymium		Yttrium		Potassium	0.1
Mercury	NR	Praseodymium		Strontium	0.008	Chlorine	0.1
Gold		Cerium		Rubidium		Sulfur	0.4
Platinum		Lanthanum		Bromine	0.008	Phosphorus	1
Iridium		Barium	0.02	Selenium		Silicon	0.4
Osmium		Cesium		Arsenic	≤0.002	Aluminum	* 0.009
Rhenium		Iodine		Germanium		Magnesium	0.2
Tungsten		Tellurium		Gallium	≤0.003	Sodium	0.1
Tantalum		Antimony		Zinc	0.06	Fluorine	≈0.6
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.005	Nitrogen	NR
Ytterbium		Cadmium	≤0.007	Cobalt	≤0.001	Carbon	NR
Thulium		Silver	0.006	Iron	0.05	Boron	0.01
Erbium		Palladium		Manganese	0.002	Beryllium	
Holmium		Rhodium		Chromium	0.05	Lithium	0.006
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.004 µg/ml
*Heterogeneous

Approved: M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 920 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 738-0404
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 22, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: KVB 14 I 678

IAD No.: 97-A197-134-31

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.04
Thorium		Gadolinium		Molybdenum	2	Titanium	0.8
Bismuth		Europium		Niobium		Scandium	≤0.01
Lead	≤0.3	Samarium		Zirconium	0.6	Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	4
Mercury	NR	Praseodymium		Strontium	0.2	Chlorine	3
Gold		Cerium		Rubidium	≤0.02	Sulfur	3
Platinum		Lanthanum		Bromine		Phosphorus	MC
Iridium		Barium	0.4	Selenium	≤0.3	Silicon	MC
Osmium		Cesium		Arsenic	≤0.04	Aluminum	1
Rhenium		Iodine	0.1	Germanium		Magnesium	3
Tungsten		Tellurium		Gallium	≤0.07	Sodium	4
Tantalum		Antimony		Zinc	0.6	Fluorine	≈8
Hafnium		Tin	≤0.2	Copper	2	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.1	Nitrogen	NR
Ytterbium		Cadmium	≤0.1	Cobalt	≤0.02	Carbon	NR
Thulium		Silver	**0.4	Iron	1	Boron	0.2
Erbium		Palladium		Manganese	0.09	Beryllium	
Holmium		Rhodium		Chromium	0.2	Lithium	0.01
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.008 µg/ml
**Heterogeneous -Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucible prior to analysis.

Approved: M Yacobs

KVB Analysis Data

Test	Sample Number	POM's	PCB's
12/2-3	298	< 1 ug/g	< 1 ug/g
12/2-6	534	< 1 ug/g	< 1 ug/g
	534 (duplicate)	< 1 ug/g	< 1 ug/g
13-18	740	90 ug/g	< 1 ug/g
13-18	282	49 ug/g	< 1 ug/g
13-18	530	3.2 ug/g	< 1 ug/g
13-18	1038	6.3 ug/g	< 1 ug/g
13-18	1032	396 ug/g	< 1 ug/g
13-18	1033	1 ug/g	< 1 ug/g
13-18	1034	8 ug/g	< 1 ug/g
13-18	1034 (duplicate)	9 ug/g	< 1 ug/g
13-24	735	513 ug/g	< 1 ug/g
	531	6.9 ug/g	< 1 ug/g
	1039	20 ug/g	< 1 ug/g
	1035	144 ug/g	< 1 ug/g
	1036	10 ug/g	< 1 ug/g
	1037	7.1 ug/g	< 1 ug/g
	103, (duplicate)	8.5 ug/g	< 1 ug/g
14	556	70.5 ug/g	< 1 ug/g
	568	104 ug/g	< 1 ug/g
	532	10.7 ug/g	< 1 ug/g
	532 (duplicate)	8.2 ug/g	< 1 ug/g
15-10	1041	< 0.1 ug/g	< 1 ug/g
	1041 (duplicate)	< 0.1 ug/g	< 1 ug/g
	1042	*	*
15-11	941	< 1 ug/l	< 1 ug/l
	1044	< 0.1 ug/g	< 1 ug/g
	1045	*	*
19-1	LF	*	*
19-2	533	< 0.1 ug/g	< 1 ug/g
	533 (duplicate)	< 0.1 ug/g	< 1 ug/g
	C	< 1 ug/l	< 1 ug/l
	C (duplicate)	< 1 ug/l	< 1 ug/l
	LF	*	*

*Sample extracts too concentrated to be able to determine an analytical value.

KVB ANALYSIS DATA

SAMPLE	POM's	PCB's
12/2 - 3 B	< 10 ug/l	< 1 ug/l
12/2 - 6 E	10 ug/l	< 1 ug/l
13/18 M	2480 ug/l	< 10 ug/l
13/18 M deep	2890 ug/l	< 10 ug/l
13/18 N	225 ug/l	< 10 ug/l
13/24 609	234 ug/l	< 10 ug/l
13/24 A	10 ug/l	< 5 ug/l
14 616	27 ug/l	< 10 ug/l

12/2-3 B	374, 376, 377
12/2-6 E	343-345, 350
13/18 M	605, 606, 607, 333
13/18 N	264, 331
13/24 A	476, 610, 608, 611, 482, 488, 494

DIESEL ENGINE

Location No. 15 Unit No.

Unit Description DIESEL ENGINE
4 STROKE V-12 CYLINDERS TURBOCHARGED-
AFTERCOOLED ENGINE
0.75 MW

Installation Date 1976

Heater Rating 1.2 MW (4.1×10^6 Btu/hr)

Burner Description CATERPILLAR

Test Fuel Combinations No 2 OIL (0.25 % SULFUR)

Fuel Temp. at Burner (°F) 361 K (190°F)

Primary Air Temp. (°F) 361 K (190°F)

Comments:

MOBILE LABORATORY DATA Test No._____

Test No. 15 Date_____ Location_____ Engr. B. HENNING

Unit No. 4 Fuel #2 OIL Capacity_____

Unit Type_____ Burner Type_____

1. Test No.	15-1		15-2		15-3		15-4		15-5	
2. Date	4-7-77		4-8-77		4-8-77		4-8-77		4-8-77	
3. Time	1315		1135		1110		1040		1100	
4. Load	380 kw		0.2 mw		0.1 mw		.3 mw		.3 mw	
5. Process Rate	—		—		—		—		—	
6. Flue Diam. or Size, ft	12"		1		1		1		1	
7. Probe Position	CENTER		CENTER		CENTER		CENTER		CENTER	
8. Oxygen (%)	10.5		15.8		13.3		11.3		10.6	
9. NOx (hot) read/3% O_2 (ppm)	975	1671	495	1713	700	1636	900	1670	950	1644
10. NO (hot) read/3% O_2 (ppm)	975	1671	495	1713	680	1590	900	1670	930	1644
11. NO_2 (hot) read/3% O_2 (ppm)	0	0	0	0	20	46	0	0	0	0
12. NO (cold) read/3% O_2 (ppm)	940	1611	340	1177	620	1449	785	1456	863	1494
13. Carbon Dioxide (%)	—		—		—		—		—	
14. Carbon Monoxide (ppm) uncor/cor	56	96	228	789	112	262	64	119	64	111
15. Hydrocarbon (ppm) uncor/cor	30	51	310	1073	110	257	20	37	17	29
16. Sulfur Dioxide (ppm) uncor/cor	65	111	80	277	60	140	60	111	60	104
17. Smoke Spot (Bacharach)	—		—		—		—		3.0	
18. Atmos. Temp. (°F/°C)	45		50		49		—		—	
19. Dew Point Temp. (°F/°C)	38		40		39		—		—	
20. Atmos. Pressure (in. Hg)	29.29		30.30		30.32		30.32		30.32	
21. Relative Humidity (%)	52		40		40		—		—	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 15-6-S

Test No. 15-6-S Date 4-12-77 Location _____ Engr. _____

Unit No. 4 Fuel #2 OIL Capacity 600 KW

Unit Type _____ Burner Type _____

1. Test No.	15-6		15-6									
2. Date	4-12-77		4-12-77									
3. Time	1300		1400									
4. Load	500 KW		500 KW									
5. Process Rate	—		—									
6. Flue Diam. or Size, ft	1		1									
7. Probe Position	CENTER		CENTER									
8. Oxygen (%)	10		9.6									
9. NOx (hot) read/3% O_2 (ppm)			980	1547								
10. NO (hot) read/3% O_2 (ppm)			955	1507								
11. NO_2 (hot) read/3% O_2 (ppm)			25	40								
12. NO (cold) read/3% O_2 (ppm)	820	1342	900	1421								
13. Carbon Dioxide (%)	—		—									
14. Carbon Monoxide (ppm) uncor/cor	~80	~131	54	85								
15. Hydrocarbon (ppm) uncor/cor	50	82	40	63								
16. Sulfur Dioxide (ppm) uncor/cor	80	131	100	157								
17. Smoke Spot (Bacharach)	—		—									
18. Atmos. Temp. (°F/°C)	52		52									
19. Dew Point Temp. (°F/°C)	51		51									
20. Atmos. Pressure (in. Hg)	30.08		30.08									
21. Relative Humidity (%)	94		94									
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 15-6-P-I

Test No. 15-6-P-I Date 4-13-77 Location 15 Engr. BWH

Unit No. 4 Fuel #2 OIL Capacity 600 KW

Unit Type _____ Burner Type _____

1. Test No.	15-6-P-I		15-6-P-I		15-6-P-I		15-6-P-I									
2. Date	4-13-77		4-13-77		4-13-77		4-13-77									
3. Time	0900		1000		1100		1145									
4. Load	500 KW		500 KW		500 KW		500 KW									
5. Process Rate																
6. Flue Diam. or Size, ft	1		1		1		1									
7. Probe Position	CEN		CEN		CEN		CEN									
8. Oxygen (%)	9.4		9.4		9.4		9.4									
9. NOx (hot) read/3% O_2 (ppm)	1020	1583	1045	1620			1025	1589								
10. NO (hot) read/3% O_2 (ppm)	998	1548	1005	1558			998	1547								
11. NO_2 (hot) read/3% O_2 (ppm)	22	34	40	62			27	42								
12. NO (cold) read/3% O_2 (ppm)	920	1426	930	1442	920	1426	930	1442								
13. Carbon Dioxide (%)	—		—		—		—									
14. Carbon Monoxide (ppm) uncor/cor	60	93	70	109	45	70	45	70								
15. Hydrocarbon (ppm) uncor/cor	45	70	45	70	50	78	40	62								
16. Sulfur Dioxide (ppm) uncor/cor	50	77	80	124	60	93	80	124								
17. Smoke Spot (Bacharach)	—		—		—		2.5									
18. Atmos. Temp. (°F/°C)	62		61		62		64									
19. Dew Point Temp. (°F/°C)	51		50		51		51									
20. Atmos. Pressure (in. Hg)	30.15		30.15		30.17		30.16									
21. Relative Humidity (%)	49		46		49		39									
22.																
23.																
24.																
25.																
26.																
27.																
28.																
29.																
30.																

MOBILE LABORATORY DATA Test No. _____

Test No. 15-7 Date 4-14-77 Location 15 Engr. B.W.H.

Unit No. 4 Fuel #2 OIL Capacity 675 KW

Unit Type DIESEL Burner Type _____

1. Test No.	15-7-P		15-7-P		15-7-P		15-7-P			
2. Date	4-14-77		4-14-77		4-14-77		4-14-77			
3. Time	0854		0935		1015		1050			
4. Load	500 KW		500 KW		400 KW		500 KW			
5. Process Rate										
6. Flue Diam. or Size, ft	1		1		1		1			
7. Probe Position	CEN.		CEN.		CEN.		CEN.			
8. Oxygen (%)	9.5		9.5		10.2		9.3			
9. NOx (hot) read/3% O_2 (ppm)	960	1503	935	1463	900	1500	930	1431		
10. NO (hot) read/3% O_2 (ppm)	925	1448	900	1409	870	1450	890	1369		
11. NO_2 (hot) read/3% O_2 (ppm)	35	55	35	55	30	50	40	62		
12. NO (cold) read/3% O_2 (ppm)	860	1346	860	1346	840	1400	870	1338		
13. Carbon Dioxide (%)	—		—		—		—			
14. Carbon Monoxide (ppm) uncor/cor	64	100	60	94	64	107	60	92		
15. Hydrocarbon (ppm) uncor/cor	30	47	35	55	32	53	35	54		
16. Sulfur Dioxide (ppm) uncor/cor	100	157	100	157	105	125	90	138		
17. Smoke Spot (Bacharach)	—		—		—		—			
18. Atmos. Temp. (°F/°C)	53		58		58		49			
19. Dew Point Temp. (°F/°C)	48		49		49		49			
20. Atmos. Pressure (in. Hg)	29.96		29.96		29.95		29.94			
21. Relative Humidity (%)	70		52		52		100			
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

MOBILE LABORATORY DATA

Test No. 15-8

Test No. 15-8 Date 4-14-77 Location 15 Engr. B.W.H.

Unit No. 4 Fuel #2 OIL Capacity 675 KW

Unit Type DIESEL Burner Type

1. Test No.	15-8		15-8		15-8		15-8			
2. Date	4-14-77		4-14-77		4-14-77		4-14-77			
3. Time	1255		1310		1325		1340			
4. Load	400KW		400 KW		400KW		400KW			
5. Process Rate										
6. Flue Diam. or Size, ft	1		1		1		1			
7. Probe Position	CEN		CEN.		CEN.		CEN.			
8. Oxygen (%)	10.0		10.0		10.2		10.2			
9. NOx (hot) read/3% O_2 (ppm)	860	1407	890	1450	860	1433	845	1408		
10. NO (hot) read/3% O_2 (ppm)	840	1377	850	1386	825	1375	820	1366		
11. NO_2 (hot) read/3% O_2 (ppm)	20	33	40	65	35	58	25	42		
12. NO (cold) read/3% O_2 (ppm)	800	1309	810	1320	785	1308	768	1280		
13. Carbon Dioxide (%)	—		—		—		—			
14. Carbon Monoxide (ppm) uncor/cor	52	85	52	85	54	90	56	93		
15. Hydrocarbon (ppm) uncor/cor	30	49	30	49	35	58	40	67		
16. Sulfur Dioxide (ppm) uncor/cor	100	164	85	139	100	167	80	133		
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)							56			
19. Dew Point Temp. (°F/°C)							55			
20. Atmos. Pressure (in. Hg)							29.90			
21. Relative Humidity (%)							95			
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 15-9-P Date 4-15-77 Location 15 Engr. B.W.H.

Unit No. 4 Fuel #2 OIL Capacity 675 KW

Unit Type DIESEL Burner Type_____

1. Test No.	15-9-P		15-9-P		15-9-P I		15-9-I,S		15-9-S	
2. Date	4-15-77		4-15-77		4-15-77		4-15-77		4-15-77	
3. Time	0845		0945		1045		1150		1310	
4. Load	400KW		400KW		400KW		400KW		400KW	
5. Process Rate										
6. Flue Diam. or Size, ft	1		1		1		1		1	
7. Probe Position	CEN.		CEN.		CEN		CEN.		CEN.	
8. Oxygen (%)	10.0		10.0		10.2		10.2		10.0	
9. NOx (hot) read/3% O_2 (ppm)	890	1450	890	1460	860	1433	875	1458	900	1473
10. NO (hot) read/3% O_2 (ppm)	850	1386	860	1410	830	1383	855	1425	870	1424
11. NO_2 (hot) read/3% O_2 (ppm)	40	65	30	49	30	50	20	33		
12. NO (cold) read/3% O_2 (ppm)	800	1304	810	1328	780	1300	800	1333	830	1358
13. Carbon Dioxide (%)	—		—		—		—		—	
14. Carbon Monoxide (ppm) uncor/cor	64	105	54	89	56	93	52	87	54	88
15. Hydrocarbon (ppm) uncor/cor	25	41	25	41	30	50	40	67	28	46
16. Sulfur Dioxide (ppm) uncor/cor	90	147	85	139	100	167	90	150	90	147
17. Smoke Spot (Bacharach)	2.5		—		2.0		—		—	
18. Atmos. Temp. (°F/°C)	57		60		60		61		62	
19. Dew Point Temp. (°F/°C)	57		57		58		58		59	
20. Atmos. Pressure (in. Hg)	30.01		30.01		30.05		30.05		30.05	
21. Relative Humidity (%)	100		80		89		84		85	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

MOBILE LABORATORY DATA

Test No. 15-10-SASS

Test No. 15-10-SASS Date 4-19-77 Location 15 Engr. W.B.N.

Unit No. 4 Fuel #2 OIL Capacity 675 KW

Unit Type DIESEL Burner Type

1. Test No.	15-10-SASS		15-10S		15-10S		15-10S		15-10S	
2. Date	4-19-77		4-19-77		4-19-77		4-19-77		4-19-77	
3. Time	0938		1000		1100		1205		1300	
4. Load KW	400		400		400		400		400	
5. Process Rate										
6. Flue Diam. or Size, ft	1.0		1.0		1.0		1.0		1.0	
7. Probe Position	CEN		CEN		CEN		CEN		CEN	
8. Oxygen (%)	9.25		10.0		10.0		10.5		10.2	
9. NOx (hot) read/3% O_2 (ppm)*	925	1560	975	1595	928	1516	900	1543	900	1500
10. NO (hot) read/3% O_2 (ppm)*	940	1504	910	1489	878	1435	870	1491	860	1433
11. NO_2 (hot) read/3% O_2 (ppm)*	35	56	65	106	50	82	30	52	40	
12. NO (cold) read/3% O_2 (ppm)*	870	1392	848	1388	820	1340	820	1406	820	1367
13. Carbon Dioxide (%)	—		—		—		—		—	
14. Carbon Monoxide (ppm) uncor/cor*	52	83	56	92	54	88	52	89	52	87
15. Hydrocarbon (ppm) uncor/cor*	40	64	80	131	20	33	30	51	30	50
16. Sulfur Dioxide (ppm) uncor/cor*	100	160	100	164	100	164	100	171	100	167
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	47		48		52		53		51	
19. Dew Point Temp. (°F/°C)	46		47		49		50		50	
20. Atmos. Pressure (in. Hg)	29.94		29.93		29.93		29.91		29.91	
21. Relative Humidity (%)							82		93	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. 15-10 SASS

Test No. 15-10 SASS Date 4-19-77 Location 15 Engr. B.W.H.

Unit No. 4 Fuel #2 OIL Capacity 675 KW

Unit Type DIESEL Burner Type

1. Test No.	15-10		15-10								
2. Date	4-19-77		4-19-77								
3. Time	1355		1445								
4. Load KW	400		400								
5. Process Rate											
6. Flue Diam. or Size, ft	1		1								
7. Probe Position	CENTER		CENTER								
8. Oxygen (%)	10.2		10.0								
9. NOx (hot) read/3% O_2 (ppm)*	910	1517	900	1473							
10. NO (hot) read/3% O_2 (ppm)*	880	1467	860	1407							
11. NO_2 (hot) read/3% O_2 (ppm)*	30		40								
12. NO (cold) read/3% O_2 (ppm)*	820	1367	810	1325							
13. Carbon Dioxide (%)	—		—								
14. Carbon Monoxide (ppm) uncor/cor*	52	87	54	88							
15. Hydrocarbon (ppm) uncor/cor*	28	47	30	49							
16. Sulfur Dioxide (ppm) uncor/cor*	100	167	100	164							
17. Smoke Spot (Bacharach)	—		—								
18. Atmos. Temp. (°F/°C)	—		52								
19. Dew Point Temp. (°F/°C)			49								
20. Atmos. Pressure (in. Hg)	29.90		29.87								
21. Relative Humidity (%)			91								
22.											
23.											
24.											
25.											
26.											
27.											
28.											
29.											
30.											

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 15-11-SASS Date 4-21-77 Location 15 Engr. BWH/MBH

Unit No. _____ Fuel #2 OIL Capacity 675 Kw

Unit Type DIESEL Burner Type _____

1. Test No.	15-11-SASS									
2. Date	4-21-77		4-21-77		4-21-77		4-21-77			
3. Time	0825		0925		1025		1125		1225	
4. Load	400 Kw		400 Kw		400 Kw		400 Kw		400 Kw	
5. Process Rate	—		—		—		—		—	
6. Flue Diam. or Size, ft	1.0		1.0		1.0		1.0		1.0	
7. Probe Position	CENTER		CENTER		CENTER		CENTER		CENTER	
8. Oxygen (%)	10.0		10.2		10.2		10.7		10.8	
9. NOx (hot) read/3% O_2 (ppm)	920	1505	940	1567	960	1600	940	1643	950	1676
10. NO (hot) read/3% O_2 (ppm)	890	1456	890	1483	920	1533	910	1590	890	1571
11. NO_2 (hot) read/3% O_2 (ppm)	30	49	50	83	40	67	30	52	60	106
12. NO (cold) read/3% O_2 (ppm)	820	1342	850	1417	840	1400	830	1450	810	1429
13. Carbon Dioxide (%)	—		—		—		—		—	
14. Carbon Monoxide (ppm) uncor/cor	52	85	60	100	52	87	48	84	48	84
15. Hydrocarbon (ppm) uncor/cor	30	49	30	50	20	33	25	44	20	35
16. Sulfur Dioxide (ppm) uncor/cor	100	164	90	150	110	184	100	175	90	159
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F)/°C)	50		49		52		53		55	
19. Dew Point Temp. (°F/°C)	43		44		44		45		46	
20. Atmos. Pressure (in. Hg)	30.14		30.14		30.14		30.18		30.19	
21. Relative Humidity (%)	56		59		59		52		50	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 15-11-SASS Date 4-21-77 Location 15 Engr. BWH/MBH

Unit No. _____ Fuel #2 OIL Capacity 675 Kw

Unit Type DIESEL Burner Type _____

1. Test No.	15-11											
2. Date	4-21-77											
3. Time												
4. Load	400 Kw											
5. Process Rate	—											
6. Flue Diam. or Size, ft	1.0											
7. Probe Position	CENTER											
8. Oxygen (%)	10.1											
9. NOx (hot) read/3% O_2 (ppm)	980	1618										
10. NO (hot) read/3% O_2 (ppm)	940	1552										
11. NO_2 (hot) read/3% O_2 (ppm)	40	66										
12. NO (cold) read/3% O_2 (ppm)	850	1404										
13. Carbon Dioxide (%)	—											
14. Carbon Monoxide (ppm) uncor/cor	52	86										
15. Hydrocarbon (ppm) uncor/cor	25	41										
16. Sulfur Dioxide (ppm) uncor/cor	100	165										
17. Smoke Spot (Bacharach)	—											
18. Atmos. Temp. (°F/°C)	52											
19. Dew Point Temp. (°F/°C)	47											
20. Atmos. Pressure (in. Hg)	30.19											
21. Relative Humidity (%)	69											
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

OPERATING DATA

Location 15

UNIT A

Test No.	15-1	15-2	15-3	15-4	15-5
Date	4-7-77	4-8-77	4-8-77	4-8-77	4-8-77
Time	1315	0845	0932	1015	1041
Test Description	AS FOUND RED. LOAD	LOAD VARIATION	LOAD VARIATION	LOAD VARIATION	LOAD VARIATION
Oil Temp., °F	190	182	188	190	195
Fuel Press.	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Eng. Oil Press., psi	80	80	80	80	80
Water Temperature, °F (Out of Heat Exchanger)	239	235	236	235	230
Steam Pressure, psi	11.0	9.0	10.0	8.0	8.0
Exhaust Temperature, °F (Into Heat Exchanger)	NOT INSTALLED	—	—	—	—
Load, MW	0.38	0.1	0.19	0.32	0.4
Current, KA	1.1	~.25	0.62	.99	1.1
Inlet Manifold Press. Right/Left, in. H_2O	— —	— —	— —	— —	— —
Aftercooler Temp. (water), °F	160	157	162	160	160
Inlet Manifold Temp. Right/Left, °F	— —	— —	— —	— —	— —
Engine RPM	1200	1200	1200	1200	1200
Load Unit B, MW/KA					
Load Unit C, MW/KA					
Load Unit D, MW/KA					
Fuel Level (in.)/Tank No.	— —	1620 1			
Fuel Consumption, gal/hr					

OPERATING DATA

Location 15

UNIT A

Test No.	15-6-S	15-6-S	15-6-S	15-6-S	
Date	4-12-77	4-12-77	4-12-77	4-12-77	
Time	1252	1320	1350	1406	
Test Description	BASELINE 50%	BASELINE 50%	BASELINE 50%	BASELINE 50%	
Oil Temp., °F	190	190	190	192	
Fuel Press.	NORMAL	NORMAL	NORMAL	NORMAL	
Eng. Oil Press., psi	80	80	80	80	
Water Temperature, °F (Out of Heat Exchanger)	235	235	234	234	
Steam Pressure, psi	10.0	10.0	9.1	9.1	
Exhaust Temperature, °F (Into Heat Exchanger)	670	740	770	765	
Load, MW	.46	.50	.50	.50	
Current, KA	1.4	1.5	1.5	1.5	
Inlet Manifold Press. Right/Left, in. H_2O	— | —	— | —	— | —	— | —	
Aftercooler Temp. (water), °F	160	160	157	157	
Inlet Manifold Temp. Right/Left, °F	195 | 195	195 | 195	210 | 200	200 | 205	
Engine RPM	1200	1200	1200	1200	
Load Unit B, MW/KA					
Load Unit C, MW/KA					
Load Unit D, MW/KA					
Fuel Level (in.)/Tank No.	1292 | 1	| 1	1263½		
Fuel Consumption, gal/hr	30		29½		

OPERATING DATA

Location 15

UNIT A

Test No.	15-6-P-I	15-6-P-I	15-6-P-I	15-6-P-I	15-6-P-I
Date	4-13-77	4-13-77	4-13-77	4-13-77	4-13-77
Time	0900	0930	1000	1030	1104
Test Description	BASELINE PARTIC	BASELINE PARTIC	BASELINE PARTIC	BASELINE PARTIC	BASELINE IMPACTOR
Oil Temp., °F	190	190	189	193	194
Fuel Press.	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Eng. Oil Press., psi	80	80	80	80	80
Water Temperature, °F (Out of Heat Exchanger)	240	231	234	236	237
Steam Pressure, psi	11.3	7.6	8.6	10.1	10.1
Exhaust Temperature, °F (Into Heat Exchanger)	615	700	700	720	740
Load, MW	.50	.50	.48	.47	.50
Current, KA	1.4	1.38	1.38	1.35	1.3
Inlet Manifold Press. Right/Left, in. H_2O	— | —	— | —	— | —	— | —	— | —
Aftercooler Temp. (water), °F	165	160	160	160	160
Inlet Manifold Temp. Right/Left, °F	190 | 187	192 | 187	160 | 180	190 | 195	195 | 193
Engine RPM	1200	1200	1200	1200	1200
Load Unit B, MW/KA					
Load Unit C, MW/KA					
Load Unit D, MW/KA					
Fuel Level (in.)/Tank No.	27 | 1	— | -	26.5 | 1	— | —	25.5 | 1
Fuel Consumption, gal/hr	—	—	28.5	—	56

OPERATING DATA

Location 15

UNIT A

Test No.	15-6-P-I		15-7		15-7		15-7		15-7	
Date	4-13-77		4-14-77		4-14-77		4-14-77		4-14-77	
Time	1131		0900		0930		1000		1035	
Test Description	BASELINE IMPACTOR		MAX AFTERCOOLING		—		—		—	
Oil Temp., °F	192		178		180		180		173	
Fuel Press.	NORMAL		—		—		—		—	
Eng. Oil Press., psi	80		80		80		80		80	
Water Temperature, °F (Out of Heat Exchanger)	236		237		235		239		238	
Steam Pressure, psi	11.0		10.0		9.8		11.7		10.2	
Exhaust Temperature, °F (Into Heat Exchanger)	770		580		620		625		715	
Load, MW	.49		.48		.50		.41		.42	
Current, KA	1.38		1.4		1.4		1.2		1.27	
Inlet Manifold Press. Right/Left, in. H_2O	—	—	—	—	—	—	—	—	—	—
Aftercooler Temp. (water), °F	165		144		140		138		139	
Inlet Manifold Temp. Right/Left, °F	195	195	172	170	176	177	169	168	169	169
Engine RPM	1200		1200		1200		1200		1200	
Load Unit B, MW/KA										
Load Unit C, MW/KA										
Load Unit D, MW/KA										
Fuel Level (in.)/Tank No.	—	—	22.0	/	—	—	21.25	/	—	—
Fuel Consumption, gal/hr	—		—		—		—		—	

OPERATING DATA

Location 15

UNIT A

Test No.	15-7		15-8		15-8		15-8		15-8	
Date	4-14-77		4-14-77		4-14-77		4-14-77		4-14-77	
Time	1100		1350		1405		1420		1435	
Test Description	MAX AFTERCOOLING		—						— ►	
Oil Temp., °F	176		178		178		178		178	
Fuel Press.	NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Eng. Oil Press., psi	80		80		80		80		80	
Water Temperature, °F (Out of Heat Exchanger)	240		235		241		235		241	
Steam Pressure, psi	11.9		9.8		12.9		10.0		12.1	
Exhaust Temperature, °F (Into Heat Exchanger)	745		640		660		650		650	
Load, MW	.50		.40		.40		.40		.40	
Current, KA	1.40		1.23		1.19		1.19		1.15	
Inlet Manifold Press. Right/Left, in. H_2O	—	—	—	-	—	—	—	—	—	—
Aftercooler Temp. (water), °F	144		135		134		135		135	
Inlet Manifold Temp. Right/Left, °F	175	173	163	162	160	160	160	160	161	160
Engine RPM	1200		1200		1200		1200		1200	
Load Unit B, MW/KA										
Load Unit C, MW/KA										
Load Unit D, MW/KA										
Fuel Level (in.)/Tank No.	20.25	1	19.25	1	—	—	—	—	—	—
Fuel Consumption, gal/hr	—									

OPERATING DATA

Location 15

UNIT A

Test No.	15-8		15-9P		15-9P		15-9P		15-9P	
Date	4-14-77		4-15-77		4-15-77		4-15-77		4-15-77	
Time	1450		0845		0915		0945		1015	
Test Description	MAX AFTERCOOLING		BASELINE PARTICULATE		→		→		→	
Oil Temp., °F	178		192		194		197		194	
Fuel Press.	NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Eng. Oil Press., psi	80		80		80		80		80	
Water Temperature, °F (Out of Heat Exchanger)	239		240		238		241		236	
Steam Pressure, psi	10.9		11.1		10.8		12.0		10.0	
Exhaust Temperature, °F (Into Heat Exchanger)	660		620		675		650		700	
Load, MW	0.40		0.39		0.40		0.40		0.40	
Current, KA	1.08		1.10		1.1		1.15		1.10	
Inlet Manifold Press. Right/Left, in. H_2O	—	—	—	—	—	—	—	—	—	—
Aftercooler Temp. (water), °F	136		154		154		157		154	
Inlet Manifold Temp. Right/Left, °F	160	160	170	178	178	182	179	179	182	180
Engine RPM	1200		1200		1200		1200		1200	
Load Unit B, MW/KA										
Load Unit C, MW/KA										
Load Unit D, MW/KA			.02	.15	.045	.18	.01	.14		
Fuel Level (in.)/Tank No.	18.75	1	17	1	16.25	1	—	—	15.5	1
Fuel Consumption, gal/hr										

OPERATING DATA

Location 15

UNIT A

Test No.	15-9P		15-9-I		15-9-I, S		15-9-S		15-9-S	
Date	4-15-77		4-15-77		4-15-77		4-15-77		4-15-77	
Time	1045		1115		1154		1215		1245	
Test Description	BASELINE PARTICULATE		IMPACTOR		IMPACTOR 50%		50%		50%	
Oil Temp., °F	190		187		190		189		189	
Fuel Press.	NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Eng. Oil Press., psi	80		80		80		80		80	
Water Temperature, °F (Out of Heat Exchanger)	240		238		242		239		240	
Steam Pressure, psi	11.9		10.8		12.3		11.2		11.2	
Exhaust Temperature, °F (Into Heat Exchanger)	725		700		720		720		720	
Load, MW	0.40		0.42		.40		.41		.40	
Current, KA	1.10		1.18		1.15		1.19		1.12	
Inlet Manifold Press. Right/Left, in. H_2O	—	—	—	—	—	—	—	—	—	—
Aftercooler Temp. (water), °F	158		157		159		160		157	
Inlet Manifold Temp. Right/Left, °F	185	180	186	180	183	181	186	181	190	185
Engine RPM	1200		1200		1200		1200		1200	
Load Unit B, MW/KA										
Load Unit C, MW/KA										
Load Unit D, MW/KA			0	.33	0	.200	0	.200	0	.200
Fuel Level (in.)/Tank No.	15.0	1			14.25	1				
Fuel Consumption, gal/hr										

OPERATING DATA

Location 15

UNIT A

Test No.	15-9-S		15-10-S		15-10-S		15-10-S		15-10-S	
Date	4-15-77		4-19-77		4-19-77		4-19-77		4-19-77	
Time	1315		0954		1035		1100		1130	
Test Description	BASELINE 50%		5455 —						→	
Oil Temp., °F	193		188		190		188		188	
Fuel Press.	NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Eng. Oil Press., psi	80		80		80		80		80	
Water Temperature, °F (Out of Heat Exchanger)	241		242		243		240		244	
Steam Pressure, psi	12.1		11.9		12.6		11.3		13.2	
Exhaust Temperature, °F (Into Heat Exchanger)	680		690		690		710		715	
Load, MW	.41		.41		.40		.41		.40	
Current, KA	1.15		1.22		1.20		1.20		1.20	
Inlet Manifold Press. Right/Left, in. H_2O	—	—	—	—	—	—	—	—	—	—
Aftercooler Temp. (water), °F	162		157		159		159		159	
Inlet Manifold Temp. Right/Left, °F	175	180	170	178	168	174	179	175	180	179
Engine RPM	1200		1200		1200		1200		1200	
Load Unit B, MW/KA										
Load Unit C, MW/KA										
Load Unit D, MW/KA	0	.3	.100	.280			.05	.17	.15	.35
Fuel Level (in.)/Tank No.	13.5	/	34.0	#2	33.75	#2			33.25	#2
Fuel Consumption, gal/hr										

OPERATING DATA

Location 15

UNIT A

Test No.	15-10-SASS		5-10-SASS		5-10-SASS		5-10-SASS		5-10-SASS	
Date	4-19-77		4-19-77		4-19-77		4-19-77		4-19-77	
Time	1200		1233		1304		1330		1400	
Test Description	BASELINE →								→	
	SASS ----								→	
Oil Temp., °F	187		188		193		189		189	
Fuel Press.	NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Eng. Oil Press., psi	80		80		80		80		80	
Water Temperature, °F (Out of Heat Exchanger)	235		236		236		240		239	
Steam Pressure, psi	9.6		9.5		9.3		11.6		10.8	
Exhaust Temperature, °F (Into Heat Exchanger)	705		720		725		715		715	
Load, MW	.39		.40		.40		.39		.39	
Current, KA	1.1		1.1		1.2		1.1		1.05	
Inlet Manifold Press. Right/Left, in. H_2O	—	-	—	—	—	—	—	—	—	—
Aftercooler Temp. (water), °F	156		156		157		157		160	
Inlet Manifold Temp. Right/Left, °F	179	179	179	179	184	184	180	181	182	176
Engine RPM	1200		1200		1200		1200		1200	
Load Unit B, MW/KA										
Load Unit C, MW/KA										
Load Unit D, MW/KA	.085	.28			.060	.20	.065	.25	.040	.25
Fuel Level (in.)/Tank No.			32.75	2			32.25	2		
Fuel Consumption, gal/hr										

OPERATING DATA

Location 15

UNIT A

Test No.	15-10-SASS		15-10-SASS		15-11 SASS		15-11 SASS		15-11 SASS	
Date	4-19-77		4-19-77		4-19-77		4-19-77		4-19-77	
Time	1430		1455		0837		0900		0930	
Test Description	BASELINE		—						→	
	SASS		→						→	
Oil Temp., °F	189		188		188		188		188	
Fuel Press.	NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Eng. Oil Press., psi	80		80		80		80		80	
Water Temperature, °F (Out of Heat Exchanger)	230		225		235		234		234	
Steam Pressure, psi	6.9		6.7		9.3		8.2		8.7	
Exhaust Temperature, °F (Into Heat Exchanger)	681		690		725		725		722	
Load, MW	.40		.38		.40		.40		.40	
Current, KA	1.13		1.05		1.11		1.16		1.10	
Inlet Manifold Press. Right/Left, in. H_2O	—	—	—	—	46.5	45.5	50.0	49.0	49.0	48.0
Aftercooler Temp. (water), °F	153		155		163		154		155	
Inlet Manifold Temp. Right/Left, °F	184	185	180	182	180	183	189	185	189	184
Engine RPM	1200		1200		1200		1200		1200	
Load Unit B, MW/KA										
Load Unit C, MW/KA										
Load Unit D, MW/KA					.030	.200	.035	.16	.040	.17
Fuel Level (in.)/Tank No.	31.75	2	31.50	2	24.0	2			23.5	2
Fuel Consumption, gal/hr										

OPERATING DATA

Location 15

UNIT A

Test No.	15-11 SASS		15-11 SASS		15-11 SASS		15-11 SASS		15-11 SASS	
Date	4-21-77		4-21-77		4-21-77		4-21-77		4-21-77	
Time	1000		1030		1100		1130		1200	
Test Description	BASELINE								→	
	SASS								→	
Oil Temp., °F	188		187		188		188		188	
Fuel Press.	NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Eng. Oil Press., psi	80		80		80		80		80	
Water Temperature, °F (Out of Heat Exchanger)	231		234		240		244		245	
Steam Pressure, psi	7.9		8.5		11.2		13.2		13.7	
Exhaust Temperature, °F (Into Heat Exchanger)	715		720		695		695		705	
Load, MW	.40		.39		.38		.39		.40	
Current, KA	1.12		1.15		1.1		1.1		1.2	
Inlet Manifold Press. Right/Left, in. H_2O	47.5	46.5	48.5	48.0	46.5	45.5	46.5	45.5	48.5	47.5
Aftercooler Temp. (water), °F	156		159		158		152		154	
Inlet Manifold Temp. Right/Left, °F	190	184	181	181	180	180	188	180	184	188
Engine RPM	1210		1210		1210		1210		1210	
Load Unit B, MW/KA										
Load Unit C, MW/KA										
Load Unit D, MW/KA	.030	.21								
Fuel Level (in.)/Tank No.			22.0	2	22.5	2			22.0	2
Fuel Consumption, gal/hr										

OPERATING DATA

Location 15

UNIT A

Test No.	15-11 BASS		15-11-SASS		15-11-SASS					
Date	4-21-77		4-21-77		4-21-77					
Time	1230		1300		1324					
Test Description	BASELINE SASS									
Oil Temp., °F	189		188		188					
Fuel Press.	NORMAL		NORMAL		NORMAL					
Eng. Oil Press., psi	80		80		80					
Water Temperature, °F (Out of Heat Exchanger)	239		237		237					
Steam Pressure, psi	11.5		10.2		10.0					
Exhaust Temperature, °F (Into Heat Exchanger)	239		237		685					
Load, MW	.40		.40		.41					
Current, KA	1.15		1.10		1.18					
Inlet Manifold Press. Right/Left, in. H_2O	49.5	48.5	49.5	48.5	48.5	47.5				
Aftercooler Temp. (water), °F	154		157		155					
Inlet Manifold Temp. Right/Left, °F	179	181	180	180	182	183				
Engine RPM	1210		1210		1210					
Load Unit B, MW/KA										
Load Unit C, MW/KA										
Load Unit D, MW/KA	.005	.15								
Fuel Level (in.)/Tank No.	22.0	2			21.25	2				
Fuel Consumption, gal/hr										

LOCATION 15

Fuel Oil Analyses

	Test 15-10 4-19-77 1230 Hours	Test 15-11 4-21-77 1100 Hours
Carbon, %	86.95	86.70
Hydrogen, %	12.79	12.65
Nitrogen, %	0.008	0.008
Sulfur, %	0.28	0.24
Ash, %	< 0.001	< 0.001
Oxygen (by difference), %	0	0.40
API Gravity at 60 °F	37.4	37.3
Gross Heat of Combustion, Btu/lb	19,520	19,400
Net Heat of Combustion, Btu/lb	18,350	18,250

PARTICULATE EMISSION CALCULATIONS

Test No. 15-6P Date 4-13-77 Location 15 Engr. HENNING

Unit No. 4 Fuel #2 OIL Sampling Train and Method JOY, METHOD 5

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} 30.19 in. Hg

Tot. Liquid Collected, V_{lc} 107.2 ml Total ~~Particulate~~ EQUIDS, M_n 48.5 m gm

Velocity Head, ΔP .55 iwg Stack Temp., Ts 357 °R Stack Area, As 0.785 ft^2

Sample Volume, Vm 62 ft^3 Stack Press., Psg -.2 iwg Excess O_2, XO_2% 9.4 %

Orifice Press. Diff., H .65 iwg Stack Gas Sp. Gravity, Gs 1.03 n.d.

Sample Time, θ 90 min Nozzle Dia., Dn 1/4 x 1/4 in. Meter Temp., T_m 535 °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	62.6	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	5.08	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	0.075	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	1.193×10^{-2}	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	1.708×10^{-6}	lb/DSCF
	c. C = Eq. 4b x 16.018×10^{3}	.0274	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	410.4	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps}} \times \frac{1.00}{Gs}$	3076	ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qwv = \text{Eq. 6} \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	1506	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	1393	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	.1928	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	181.7	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	.0286	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	12.3	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	115.0	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS

Test No. 15-6P Date 4-13-77 Location 15 Engr. HENNING

Unit No. 4 Fuel #2 OIL Sampling Train and Method JOY, METHOD 5

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} 30.19 in. Hg

Tot. Liquid Collected, V_{lc} 107.2 ml Total Particulate, M_n 126.4 m gm

Velocity Head, ΔP .55 iwg Stack Temp., Ts 857 °R Stack Area, As 0.785 ft^2

Sample Volume, Vm 62 ft^3 Stack Press., Psg -.2 iwg Excess O_2, XO_2% 9.4 %

Orifice Press. Diff., H .65 iwg Stack Gas Sp. Gravity, Gs 1.03 n.d.

Sample Time, θ 90 min Nozzle Dia., Dn 1/8 + 1/4 in. Meter Temp., T_m 535 °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	62.6	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	5.08	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	0.075	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	3.110×10^{-2}	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	4.452×10^{-6}	lb/DSCF
	c. C = Eq. 4b x 16.018×10^{3}	.0713	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	410.4	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	3076	ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = \text{Eq. 6} \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	1506	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	1393	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	.3721	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	181.7	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	.0746	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	32.1	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	115.0	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS

Test No. 15-6I Date 4-13-77 Location 15 Engr. _____

Unit No. _____ Fuel #2 DIESEL Sampling Train and Method _____

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} 30.15 in. Hg

Tot. Liquid Collected, V_{lc} _____ ml Total Particulate, M_n _____ m gm

Velocity Head, ΔP 0.65 iwg Stack Temp., Ts 860 °R Stack Area, As _____ ft^2

Sample Volume, Vm 15 ft^3 Stack Press., Psg -.22 iwg Excess O_2, XO_2% _____ %

Orifice Press. Diff., H 0.86 iwg Stack Gas Sp. Gravity, Gs _____ n.d.

Sample Time, θ 22.5 min Nozzle Dia., Dn 1/4 in. Meter Temp., T_m _____ °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	15.14 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	1.23 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.075 # FROM PARTIC TEST N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	_____ grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	_____ lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	_____ grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	409.8 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps}} \times \frac{1.00}{Gs}$	3403 ft/min
7. Stack Gas Flow Rate @ 70°F	a. Qsw = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	_____ WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	_____ DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	_____ lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	_____ N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	_____ lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	_____ ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	101 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

FLOW RATE = $\frac{15.14\ SCF}{22.5\ min}$ = 0.673 SCFM

PARTICULATE EMISSION CALCULATIONS

Test No. 15-9P Date 4-15-77 Location 15 Engr. B.W.N.

Unit No. 4 Fuel #2 OIL Sampling Train and Method JOY, METHOD #5

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} 30.01 in. Hg

Tot. Liquid Collected, V_{lc} 118 ml Total SOLIDS, M_n 49.5 m gm

Velocity Head, ΔP .35 iwg Stack Temp., Ts 856 °R Stack Area, As 0.785 ft^2

Sample Volume, Vm 62 ft^3 Stack Press., Psg -.08 iwg Excess O_2, XO_2% 10.0 %

Orifice Press. Diff., H .46 iwg Stack Gas Sp. Gravity, Gs 1.03 n.d.

Sample Time, θ 121 min Nozzle Dia., Dn 1/4 in. Meter Temp., T_m 539 °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	62.2	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	5.59	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	8.25×10^{-2}	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	.0114	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	1.63×10^{-6}	lb/DSCF
	c. C = Eq. 4b x 16.018×10^{3}	.026	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	408	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps}} \times \frac{1.00}{Gs}$	2460	ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	1199	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	1100	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	.108	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	191.7	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	.029	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	12.4	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	107.6	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$ (°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS

Test No. 15-9P Date 4-15-77 Location 15 Engr. B.W.H.

Unit No. 4 Fuel #2 OIL Sampling Train and Method JOY, METHOD 5

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} 30.01 in. Hg

Tot. Liquid Collected, V_{lc} 118 ml Total Particulate, M_n 187.1 m gm

Velocity Head, ΔP .35 iwg Stack Temp., Ts 856 °R Stack Area, As 0.785 ft^2

Sample Volume, Vm 62 ft^3 Stack Press., Psg -.08 iwg Excess O_2, XO_2% 10.0 %

Orifice Press. Diff., H .46 iwg Stack Gas Sp. Gravity, Gs 1.03 n.d.

Sample Time, θ 121 min Nozzle Dia., Dn 1/4 in. Meter Temp., T_m 539 °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	62.2 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	5.59 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	8.25×10^{-2} N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	.0449 grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	6.43×10^{-6} lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	.103 grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	408 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps}} \times \frac{1.00}{Gs}$	2460 ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = \text{Eq. 6} \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	1199 WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	1100 DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	.425 lb/hr
9. XO_2 factor	$XO_2 f = 2090/(20.9 - XO_2\%)$	191.7 N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	.114 lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	48.9 ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	107.6 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS

Test No. 15-9 I Date 4-15-77 Location 15 Engr. B.W.N.

Unit No. _____ Fuel #2 O/L Sampling Train and Method _____

Pitot Factor, Fs _____ Barometric Pressure, P_{bar} 30.05 in. Hg

Tot. Liquid Collected, V_{lc} _____ ml Total Particulate, M_n _____ m gm

Velocity Head, ΔP 0.35 iwg Stack Temp., Ts 860 °R Stack Area, As _____ ft^2

Sample Volume, Vm 20.0 ft^3 Stack Press., Psg -.08 iwg Excess O_2, XO_2% _____ %

Orifice Press. Diff., H _____ iwg Stack Gas Sp. Gravity, Gs _____ n.d.

Sample Time, θ 41 min Nozzle Dia., Dn 1/4 in. Meter Temp., T_m _____ °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	20.09 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	1.75 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.08 N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	_____ grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	_____ lb/DSCF
	c. C = Eq. 4b x 16.018 x 10^3	_____ grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	408.6 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta PTs} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	2500 ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	_____ WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	_____ DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	_____ lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	_____ N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	_____ lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	_____ ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	100.98 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by 530/T_m(°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS (SASS)

Test No. 15-10 Date 4-19-77 Location 15 Engr. R. H.

Unit No. 4 Fuel [illegible] Sampling Train and Method _____

Pitot Factor, Fs 0.83 Barometric Pressure, P_{bar} 29.89 in. Hg

Tot. Liquid Collected, V_{lc} _____ ml Total Particulate, M_n 236.7 m gm

Velocity Head, ΔP 0.30 iwg Stack Temp., Ts 874 °R Stack Area, As .785 ft^2

Sample Volume, Vm 622 ft^3 Stack Press., Psg .07 iwg Excess O_2, XO_2% 10.1 %

Orifice Press. Diff., H 2.05 iwg Stack Gas Sp. Gravity, Gs _____ n.d.

Sample Time, θ 500 min Nozzle Dia., Dn 1/8 in. Meter Temp., T_m _____ °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	624.1	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	37.4	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.056	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	0.00584	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	8.36×10^{-7}	lb/DSCF
	c. C = Eq. 4b x 16.018 x 10^3	1.34×10^{-2}	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	406.6	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	2340	ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsv = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	1113	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	1050	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	5.27×10^{-2}	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	194	N.D.
10. Emission	a. E = Eq. 4b x Fs x Eq. 9	1.49×10^{-2}	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	6.43	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	114	%

	Oil	Gas	Coal
Fs SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by 530/T_m(°R) if meter not temp. compensated.

Data Sheet 6002-4

Cyclone Flow = $\frac{37.4 + 624.1}{500}\ \frac{SCF}{MIN} \times \frac{874}{530}$ =

PARTICULATE EMISSION CALCULATIONS (SASS)

Test No. 15-11 Date 4-21-77 Location 15 Engr. _____

Unit No. 4 Fuel #2 DIESEL Sampling Train and Method _____

Pitot Factor, Fs 0.83 Barometric Pressure, P_{bar} 30.14 in. Hg

Tot. Liquid Collected, V_{lc} 838 ml Total Particulate, M_n 236.4 m gm

Velocity Head, ΔP .35 iwg Stack Temp., Ts 575 °R Stack Area, As 0.785 ft^2

Sample Volume, Vm 628.2 ft^3 Stack Press., Psg -.065 iwg Excess O_2, XO_2% 10.3 %

Orifice Press. Diff., H 2.2 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 300 min Nozzle Dia., Dn 0.5 in. Meter Temp., T_m _____ °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	635.8	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	39.7	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.059	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	0.0057	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	8.198×10^{-7}	lb/DSCF
	c. C = Eq. 4b x 16.018 x 10^3	1.31×10^{-2}	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	409.8	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	2518	ft/min
7. Stack Gas Flow Rate @ 70°F	a. Qsw = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	1206	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	1134	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	2.53×10^4	lb/hr
9. XO_2 factor	$XO_2 f = 2090/(20.9 - XO_2\%)$	197	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	1.49×10^{-2}	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	6.387	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	108	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by 530/T_m(°R) if meter not temp. compensated. Data Sheet 6002-4

CYCLONE FLOW = $(635.8 + 39.7) \times \frac{575}{530} \times \frac{1}{300}$ = 3.72 M/R CFM

PARTICULATE CALCULATION SHEET

Test Crew HAGERTY PIONESSA

Test No. 15-6-P Date 4-13-77 Location 15

Box No. 1 Sample Probe Position STACK

Test Description

Dry Gas Meter Vol. (ft^3)

Final 3280.23

Initial 3218.23

Total 62.00

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final	174	118	2	653.0	947.0
Initial	100	100	0	639.8	839.8
Δ Vol	74	18	2	13.2	107.2

Beaker No.	5	2	3	ACETONE BLANK 4	H_2O BLANK 1	Filter No. 25	Blank No. 26
Date Weighed	4/8/77						
Tare Wt. 1	98.9305	100.6056	101.9812	100.7858	100.0753	.8339	.8456
2	✓	✓	✓	✓	✓	.8339	.8456
3							
4							
5							
6							
Avg	98.9305	100.6056	101.9812	100.7858	100.0753	.8339	.8456
Bottle No.	1+2	3	4				
Content	Impinger (Water)	Probe (Acetone)	Probe (Water)	Cyclone (Acetone)	Flask (Dry)		
Rinse (ml)	625	525	200	100	100		
Date Weighed or 250 Bake	4-14-77						
Final Wt. 250 1	99.0155	100.6158	101.9869	100.7890	100.0781	.8755	.8457
2	99.0153	✓	101.9865	100.7892	✓	✓	✓
3							
4							
5							
6							
Avg	99.0154	100.6158	101.9867	100.7891	100.0781	.8755	.8457
Residue wt Final 250-Tare	.0849	.0102	.0055	.0033	.0028	.0416	0
Date Weighed or 650 Bake							
Final Wt. 650 1							
2							
3							
4							
5							
6							
Avg							
Residue Wt Final 650-Tare							

Comments:

Data Sheet 6002-3

PARTICULATE CALCULATION SHEET

Test No. 15-9P Date 4-15-77 Location 15 Test Crew PIONEESSA
Box No. _____ Sample Probe Position _____
Test Description _____

Dry Gas Meter Vol. (ft^3)
Final 3422.00
Initial 3360.00
Total 62.00

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final	182	116	2	661	961.0
Initial	100	100	0	643	843.0
Δ Vol	82	16	2	18	118.0

Beaker No.		7	8	9			Filter No. 26	Blank No. 29
Date Weighed		4-8-77						
Tare Wt.	1	104.0015	99.3336	100.1812			4-13-77	4-8-77
	2	✓	✓	✓			.8457	.8458
	3						✓	✓
	4							
	5							
	6							
	Avg	104.0015	99.3336	100.1812			.8457	.8458
Bottle No.								
Content		Impinger (Water)	Probe (Acetone)	Probe (Water)	Cyclone (Acetone)	Flask (Dry)		
Rinse (ml)		425	300	275				
Date Weighed or 250 Bake		4-18-77						
Final Wt. 250	1	104.1263	99.3428	100.1940			.8841	.8459
	2	✓	✓	✓			✓	.8460
	3							
	4							
	5							
	6							
	Avg	104.1263	99.3428	100.1940			.8661	.8459
Residue wt Final 250-Tare		.1248	.0092	.0128			.0404	+.0001
Date Weighed or 650 Bake								
Final Wt. 650	1							
	2							
	3							
	4							
	5							
	6							
	Avg							
Residue Wt Final 650-Tare								

Comments:

Data Sheet 6002-3

PLANT
LOCATION 15
OPERATOR HENNING + PIONESSA
DATE 4-13-77
RUN NO. 15-6-P
SAMPLE BOX NO.
METER BOX NO. 9-11-1091
METER H
: FACTOR @

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 52
BAROMETRIC PRESSURE 30.19
ASSUMED MOISTURE, % 9
HEATER BOX SETTING
PROBE LENGTH, IN. 48
NOZZLE DIAMETER, IN. 1/8 + 1/4
PROBE HEATER SETTING

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time ~~(e)Min.~~ CLOCK TIME	Static Pressure (P_s), In. ~~Hg~~ H_2O	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter: Inlet ($T_{min.}$) °F	Gas Sample Temperature at Dry Gas Meter: Outlet (T_{mout}) °F	Sample Box Temperature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
	0901	-.2	380	.65	.55	3218.23		58	345	50
	0911	CHANGED FROM 1/8 NOZZLE				3234.00 TO 1/4 NOZZLE			—	—
	0915		400	.65	.86	3224.00		65	320	50
	0930		400	.65	.86	3234.50		70	315	52
	1000		400	.65	.86	3256.00		80	340	52
	1015		400	.65	.86	3266.00		85	350	51
	1035		400	.65	.86	3280.23		90	350	59
TOTAL								AVG.	AVG.	

PLANT
LOCATION 15
OPERATOR R.P. + HEMMING
DATE 4-13-77
RUN NO. 15-6I
SAMPLE BOX NO.
METER BOX NO. 4-11-1091
METER H
C FACTOR @

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 30.15
ASSUMED MOISTURE, % 8
HEATER BOX SETTING
PROBE LENGTH, IN.
NOZZLE DIAMETER, IN. 1/4
PROBE HEATER SETTING

SCHEMATIC OF STACK CROSS SECTION ANDERSON IMPACTOR

Traverse Point Number	Sampling Time ~~(c)Min.~~ CLOCK TIME	Static Pressure (P_s), In. ~~H2O~~ H_2O	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
	1110	-.22	400	.65	.86	3280.5		80		68
	1120		400	.65	.86	3287.0		80		64
	1130		400	.65	.86	3294.0		85		65
	1132		400			3295.50				
TOTAL								AVG.	AVG.	

PLANT
LOCATION 15
OPERATOR R.P.
DATE 4-15-77
RUN NO. 15-9P
SAMPLE BOX NO.
METER BOX NO.
METER H
: FACTOR @

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 57
BAROMETRIC PRESSURE 30.01
ASSUMED MOISTURE, %
HEATER BOX SETTING
PROBE LENGTH, IN.
NOZZLE DIAMETER, IN. 1/4
PROBE HEATER SETTING

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time ~~(elapsed)~~ CLOCK TIME	Static Pressure (P_g), In. ~~H2O~~ H_2O	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
	0845	-.0%	380	.33	.45	3360.00		62	300	130
	0900		395	.35	.46	3368.00		65	315	210
	0915		400	.35	.46	3376.00		75	320	225
	0930		400	.35	.46	3384.00		82	315	230
	1015		400	.35	.46	3406.00		92	325	245
	1046		400	.35	.46	3422.00		95	335	245
TOTAL								AVG.	AVG.	
AVERAGE								AVG.		

PLANT
LOCATION 15
OPERATOR BWH
DATE 4-15-77
RUN NO. 15-9-1
SAMPLE BOX NO.
METER BOX NO.
METER H
C FACTOR

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 30.05
ASSUMED MOISTURE, %
HEATER BOX SETTING
PROBE LENGTH, IN.
NOZZLE DIAMETER, IN. 14
PROBE HEATER SETTING

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time ~~(c)Min.~~ CLOCK TIME	Static Pressure (P_g), In. ~~H2O~~ H_2O	Stack Temperature (T_s) °F	Velocity Head (P_s)	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
	1100	-.08	400	.35	.46	3422.10		93		60
	1115		400	.35	.46	3429.50		93		62
	1130		400	.35	.46	3436.80		98		62
	1141		400	.35	.46	3442.10		99		63
TOTAL								AVG.	AVG.	
AVERAGE								AVG.		

ANDERSEN CASCADE IMPACTOR DATA

Test No. 15-6I Location 15 Owner _____

Impactor No. 1 Nozzle Size 1/4 Filter No. _____

Stack Temperature 400 °F Impactor Flow Rate _____ CFM

Plate	Tare (g)	Final (g)	Net (g)	%	Cum. %	ECD (μ)
1	27.3111	27.3119	.0008	5.2	100.0	11.7 - 14.2
2	28.4448	28.4471	.0023	14.8	94.8	7.2 - 8.7
3	29.2893	29.2919	.0026	16.8	80.0	4.9 5.9
4	21.9807	21.9829	.0022	14.2	63.2	3.4 4.1
5	17.8523	17.8536	.0013	8.4	49.0	2.2 2.7
6	17.9619	17.9629	.0010	6.4	40.6	1.1 1.3
7	17.9741	17.9755	.0014	9.0	34.2	.68 .82
8	28.3729	28.3750	.0021	13.5	25.2	.46 .56
Back Up Filter	21.7605	21.7623	.0018	11.7	11.7	

NOTE: FILTERS LOOKED BLACK WITH SOOT, BUT WERE LIGHT IN WEIGHT

858

ANDERSEN CASCADE IMPACTOR DATA

4-15-77

Test No. 15-9 I Location 15 Owner

Impactor No. 1 Nozzle Size 1/4 Filter No.

Stack Temperature 400 °F Impactor Flow Rate 0.49 5 CFM

Plate	Tare (g)	Final (g)	Net (g)	%	Cum. %	ECD (μ)
1	27.3131	27.3143	.0012	2.9	100	14 – 16.9
2	28.4480	28.4505	.0025	6.0	97.1	8.6 10.4
3	29.2908	29.2929	.0021	5.0	91.0	5.8 7.0
4	21.9800	21.9820	.0020	4.8	86.1	4.0 4.8
5	17.8526	17.8551	.0025	6.0	81.3	2.6 3.1
6	17.9605	17.9631	.0026	6.2	75.3	1.3 1.6
7	17.9749	17.9781	.0032	7.7	69.1	.8 .97
8	28.3755	28.3807	.0052	12.5	61.4	.55 .66
Back Up Filter	21.7607	21.7810	.0203	48.9	48.9	

* 21.7791 .0416

AFTER BAKING @ 350°F FOR 1HR.
IT LOOKED AS IF IT MIGHT HAVE GOT
SOME H_2O ON THE FILTER

Data Sheet 6002-5

PLUME OPACITY OBSERVATION RECORD

Test Run No. 15-6 P+I

LOCATION NO. 15 OBSERVER M.B.H.

OWNER _____ BOILER NO. _____ CAPACITY 500 KW ~~lb/hr~~

DATE 4-13-77 FUEL TYPE _____ BURNER TYPE _____

POINT OF EMISSION _____

POINT OF OBSERVATION 12" STACK, NOT POSSIBLE TO READ FROM ROOF,
OPTIMUM OBSERVATION DISTANCE NOT POSSIBLE

TEST No.	Time am/pm	Type	Test Load k#/hr	Opacity %	WIND Speed mph	WIND Direct	Sky Cond.	Sun Position	Comments
1	1009	PARTICULATE		5	~5	SW	CLEAR SKY		
2	:15			5					
3	:30			10					
4	:45			5					
5	1010			5					
6	:15			5					
7	30			5					
8	45			5					
9	1011			5					
10	15			0					
11	30			5					
12	45			5					
13	1012			0					
14	15			5					
15	30			5					
16	45			5					

PLUME OPACITY OBSERVATION RECORD

Test Run No. 15-6 P4I

LOCATION NO. 15 OBSERVER M.B.N.

OWNER _____ BOILER NO. _____ CAPACITY _____ klb/hr

DATE 4-13-77 FUEL TYPE _____ BURNER TYPE _____

POINT OF EMISSION _____

POINT OF OBSERVATION _____

TEST No.	TEST Time am/pm	TEST Type	Test Load k#/hr	Opacity %	WIND Speed mph	WIND Direct.	Sky Cond.	Sun Position	Comments
17	1013	PARTICULATE		5	~5	SW	CLEAR SKY		
18	15			10					
19	30			5					
20	45			5					
21	1014			5					
22	15			5					
23	30			5					
24	45			10					

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 4-13-77 _____

Location: 15 _____

Unit: 4 _____

Test: 15-6 PTI Personnel: HENNING

Fuel: #2 OIL _____

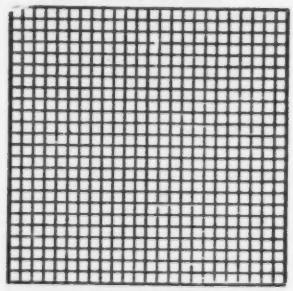
Barometric Press. (in. Hg): 30.19

Absolute Static Press. in Stack (in. H_2O / Hg): -.2 (P_g)

Pitot Tube Coefficient: .83 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
		6"10	.65	380	860			

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 4-15-77 _____

Location: 15 _____

Unit: 4 _____

Test: 15-9-P+S Personnel: B.W.N.

Fuel: #2 O/L _____

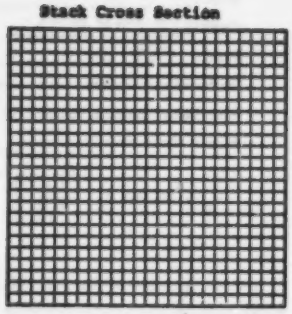
Barometric Press. (in. Hg): 30.01

Absolute Static Press. in Stack (in. H_2O): -.08 (P_g)

Pitot Tube Coefficient: .83 (C_p)

$$V_g = 85.48\ C_p \left[\frac{T_g \Delta P}{P_g M_g}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_g	Molecular Wt. M_g	Velocity (ft/sec) V_g	O_2 Conc. (% Dry)
		CENTER	.33	380	840			

6003-13

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 4-19-77

Location: 15

Unit: 4

Test: 15-10 Personnel: M.B. M R.P.

Fuel: #2 OIL

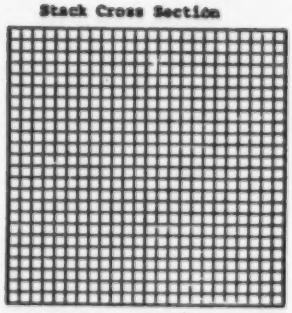
Barometric Press. (in. Hg): 29.91

Absolute Static Press. in Stack (in. H_2O): .07 (P_g)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Point Port	Traverse Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
	STACK	6"	.35	417	877			

6003-13

VELOCITY TRAVERSE

Project: EPA PHASE III SASS Test Description: 400 Kw BASELINE

Date: 4-21-77

Location: 15

Unit:

Test: 15-11 Personnel: PIONESSA

Fuel: #2 OIL

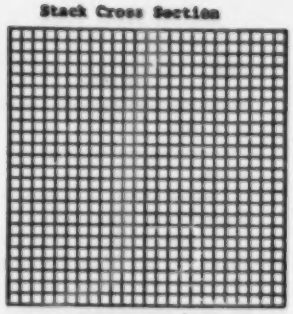
Barometric Press. (in. Hg): 30.14

Absolute Static Press. in Stack (in. Hg): -.065 (P_s)

Pitot Tube Coefficient: .83 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
	STACK	6"	.37 (AVG)	422				

8002-13

Date 4-12-77

KVB, INC.

Test No. 15-6-5

SOx DATA SHEET

TEST NO. 15-6-5 UNIT NO. 4 FUEL #2 OIL LOAD 500 KW Location 13"

Box No.	X-2	X-2			
Time	1351	1309			
Temp. in Gas Meter	51	51			
Press. in Gas Meter	0	0			
Meter Reading	0	1.00			
Barom. Press.	30.10	30.10			
Percent Oxygen	10.0	10.0			
N_2 Purge Time	1310	1333			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V (P + p)}$

Excess O_2 10.0 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	7.7	7.6	
B = Ml of lead perchlorate used for bland =	6.1	6.1	
N = Normality of lead perchlorate titrant =	.0105	.0105	
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	511	511	
V = Volume of gas sample ft^3 =	1.00	1.00	
P = Barometric pressure =	30.10	30.10	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	68	6.4	=
, gm/dscm =			
Emission, E_2 g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 4-12-77

K V B. INC.

Test No. 15-6-5

SOx DATA SHEET

TEST NO. 15-6-5 UNIT NO. 4 FUEL #2 oil LOAD 500 ~~lbs/hr~~ KW Location 15

Box No.	Z-1	Z-1			
Time	1314	1332			
Temp. in Gas Meter	51	51			
Press. in Gas Meter	0	0			
Meter Reading	0	1.00			
Barom. Press.	30.10	30.10			
Percent Oxygen	10.0	10.0			
N_2 Purge Time	1374	1403			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V (P + p)}$

Excess O_2 10.0 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	7.8	7.9	
B = Ml of lead perchlorate used for bland =	6.1	6.1	
N = Normality of lead perchlorate titrant =	.0105	.0105	
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	511	511	
V = Volume of gas sample ft^3 =	1.00	1.00	
P = Barometric pressure =	30.10	30.10	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	73	7.7	
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 4-12-77

K V B. INC.

Test No. 15-6-S

SOx DATA SHEET

TEST NO. 15-6-S UNIT NO. 4 FUEL #2 oil LOAD 580 KW Location 13

Box No.	X-2	X-2			
Time	1341	1402			
Temp. in Gas Meter	51	52			
Press. in Gas Meter	0	0			
Meter Reading	0	1.00			
Barom. Press.	30.10	30.10			
Percent Oxygen	10.0	10.0			
N_2 Purge Time	1405	1431			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V (P + p)}$

Excess O_2 10.0 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	7.8	7.8	
B = Ml of lead perchlorate used for bland =	6.1	6.1	
N = Normality of lead perchlorate titrant =	.0105	.0105	
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	511	511	
V = Volume of gas sample ft^3 =	1.00	1.00	
P = Barometric pressure =	30.10	30.10	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	73	7.2	
, ng/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$ where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 4-15-77

KVB, INC.

Test No. 15-9-5

SOx DATA SHEET

TEST NO. 15-9-5 UNIT NO. 4 FUEL #2 OIL LOAD 400 KW ~~lbs/hr~~ Location 15'

Box No.	Z-1	Z-1			
Time	1157	1211			
Temp. in Gas Meter	70	70			
Press. in Gas Meter	0	0			
Meter Reading	0	1.000			
Barom. Press.	30.05"	30.05"			
Percent Oxygen	10.1	10.1			
N_2 Purge Time	1212	1232			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V\,(P + p)}$

Excess O_2 10.1 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	6.7	6.8	
B = Ml of lead perchlorate used for bland =	4.6	4.6	
N = Normality of lead perchlorate titrant =	.0102	.0102	
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	530	530	
V = Volume of gas sample ft^3 =	1.000	1.000	
P = Barometric pressure =	30.05	30.05	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	92	9.6	
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 4-15-77

KVB, INC.

Test No. 15-95

SOx DATA SHEET

TEST NO. 15-95 UNIT NO. 4 FUEL #2 OIL LOAD 400 ~~klb/hr~~ KW Location 15

Box No.	2-2	2-2			
Time	1218	1232			
Temp. in Gas Meter	71	73			
Press. in Gas Meter	0	0			
Meter Reading	0	1.000			
Barom. Press.	30.05	30.05			
Percent Oxygen	10.1	10.1			
N_2 Purge Time	1233	1300			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V\,(P + p)}$

Excess O_2 10.1 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	6.7	12.0	
B = Ml of lead perchlorate used for bland =	4.6	4.6	
N = Normality of lead perchlorate titrant =	.0102	.0102	
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	532	532	
V = Volume of gas sample ft^3 =	1.000	1.000	
P = Barometric pressure =	30.05	30.05	
p = Pressure in gas meter =	0	0	
Concentration, C, ppu =	92	32.2	
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date 4-15-77

K V B, INC.

Test No. 15-9-3

SOx DATA SHEET

TEST NO. 15-9S UNIT NO. 4 FUEL #2 OIL LOAD 400 KW ~~[illegible]~~ Location 15

Box No.	X-1	X-1			
Time	1242	1301			
Temp. in Gas Meter	73	73			
Press. in Gas Meter	0	0			
Meter Reading	0	1.000			
Barom. Press.	30.05	30.05			
Percent Oxygen	10.1	10.1			
N_2 Purge Time	1302	1326			

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V\ (P + p)}$

Excess O_2 10.1 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	6.6	6.8	
B = Ml of lead perchlorate used for bland =	4.6	4.6	
N = Normality of lead perchlorate titrant =	.0102	.0102	
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	533	533	
V = Volume of gas sample ft^3 =	1.000	1.000	
P = Barometric pressure =	30.05	30.05	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	88	9.6	
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - xO_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____ dscm/10^4 cal

_____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

LOCATION 15

Fuel Tank Capacity Chart

Inches	Gallons	Inches	Gallons
1	9	43	2076
2	25	44	2138
3	46	45	2198
4	70	46	2259
5	98	47	2320
6	128	48	2380
7	160	49	2441
8	195	50	2501
9	232	51	2561
10	271	52	2620
11	311	53	2679
12	353	54	2738
13	397	55	2795
14	442	56	2854
15	488	57	2912
16	535	58	2968
17	584	59	3025
18	633	60	3080
19	685	61	3135
20	735	62	3189
21	788	63	3242
22	841	64	3295
23	895	65	3346
24	950	66	3397
25	1006	67	3447
26	1062	68	3495
27	1119	69	3543
28	1176	70	3589
29	1235	71	3634
30	1292	72	3677
31	1351	73	3719
32	1410	74	3760
33	1470	75	3798
34	1529	76	3835
35	1590	77	3870
36	1650	78	3902
37	1710	79	3933
38	1771	80	3960
39	1832	81	3985
40	1893	82	4005
41	1954	83	4021
42	2015	84	4030

TABLE TRACE SPECIES AND ORGANICS
SAMPLING CONDITIONS - LOCATION 15 DIESEL ENGINE

TS&O Run No.	1	2
Test No.	15-10	15-11
Date	4/19/77	4/21/77
Port Location	℄ (6")	℄ (6")
Velocity, m/s (f/s)	11.9 (39)	12.8 (42)
Stack Temp., K (°F)	485 (414)	486 (415)
Oxygen Content, % dry	10.1	10.3
Moisture, %	5.6	5.9
Sample time, min.	300	300
Cyclone Flow, awcmm (awcfm)	0.103 (3.64)	0.105 (3.72)
Isokinetic Rate, %	114	108
Oven Temp., K (°F)	479 (403)	482 (408)
XAD-2 Temp., K (°F)	291 (64)	290 (61)
Meter Temp., K (°F)	298 (77)	302 (83)
Nozzle Size, mm (in.)	12.7 (0.5)	12.7 (0.5)
No. Filters Used	1	1
Sample Flow, Dry, scmm (scfm)	0.059 (2.08)	0.060 (2.12)
Volume Collected, Dry, scm (scf)	17.55 (624.1)	18.00 (635.8)
Particulate weight, g	0.2367	0.2364
Solid Particulates, ng/J (lb/MMBtu)	6.43 (0.0149)	6.39 (0.0149)

KVB

SASS SAMPLING CONDITIONS

Test Site Location 15

Sample Port Location STACK

Stack Conditions: Stack Velocity 2340 ft/min ÷ 60 = V_s = 39.0 ft/sec

Stack Temp. 415 °F + 460 = T_s = 875 °R

Stack Moisture; B_{wo} = 8.25%

Particulate Loading (Method 5), C = 0.026 grams/DSm^3

Probe Nozzle Size for 4.0 ACFM (wet) through cyclones at 400 °F:

Isokinetic Size = 0.1192 x $\sqrt{T_s/V_s}$ = 0.565 inches

Closest Actual Nozzle Size, D_n = 0.50 inches

% Isokinetic @ 4 WACFM, Actual Nozzle = 1.421 x $T_s/(V_s \times D_n^2)$ = 127.5 %

If % Iso not in range of 90 to 110%, Adjust Cyclone Flow by:

Q_{cyc} = 2.814 x (% Iso) x V_s x D_n^2/T_s = 3.449 wet ACFM

If % Iso @ 4 WACFM is greater than 110, use (% Iso) = 110
If % Iso @ 4 WACFM is less than 90, use (% Iso) = 90

Orifice Pressure Differential, H

Meter Temp., T_m = 60 °F + 460 = 520 °R (use 560 °R for estimate)

Meter Flow Rate, Q_m = Q_{cyc} x T_m x (1. - B_{wo})/860 = 1.913 DCFM

Orifice No. (1, 2, 3) = 2, J = 0.78, D_o = 0.281, J x D_o^2 = 0.062

Orifice Press Diff., H = 1.108 x $(Q_m/J\ D_o^2)^2/T_m$ = 2.05 in. H_2O

Dry Gas Volume to be Collected (5 hour run)

V_m = Q_m x 60 x 5 = 573.9 DCF

Estimated Condensate Collection

V_{lc} = V_m x 530 x $B_{wo}/[0.0474 \times T_m \times (1. - B_{wo})]$ = 379.4 ml

Estimated Particulate Collection

M_n = C x V_m x 530/(T_m x 35.3) = 0.431 grams

KVB

SASS SAMPLING CONDITIONS

Test Site Location 15

Sample Port Location _____

Stack Conditions: Stack Velocity 2340 ft/min ÷ 60 = V_s = 39.0 ft/sec

Stack Temp. 415 °F + 460 = T_s = 875 °R

Stack Moisture; B_{wo} = .0700 (est.)

Particulate Loading (Method 5), C = 0.026 grams/DSm^3

Probe Nozzle Size for 4.0 ACFM (wet) through cyclones at 400 °F:

Isokinetic Size = 0.1192 x $\sqrt{T_s/V_s}$ = 0.565 inches

Closest Actual Nozzle Size, D_n = 0.5 inches

% Isokinetic @ 4 WACFM, Actual Nozzle = 1.421 x $T_s/(V_s x D_n^2)$ = 126.5 %

If % Iso not in range of 90 to 110%, Adjust Cyclone Flow by:

Q_{cyc} = 2.814 x (% Iso) x V_s x D_n^2/T_s = 3.449 wet ACFM

If % Iso @ 4 WACFM is greater than 110, use (% Iso) = 110
If % Iso @ 4 WACFM is less than 90, use (% Iso) = 90

Orifice Pressure Differential, H

Meter Temp., T_m = 85 °F + 460 = 545 °R (use 560 °R for estimate)

Meter Flow Rate, Q_m = Q_{cyc} x T_m x (1. - B_{wo})/860 = 2.03 DCFM

Orifice No. (1, 2, 3) = 2, J = 0.78, D_o = 0.281, J x D_o^2 = 0.062

Orifice Press Diff., H = 1.108 x $(Q_m/J D_o^2)^2/T_m$ = 2.21 in. H_2O

Dry Gas Volume to be Collected (5 hour run)

V_m = Q_m x 60 x 5 = 609 DCF

Estimated Condensate Collection

V_{lc} = V_m x 530 x $B_{wo}/[0.0474 x T_m x (1. - B_{wo})]$ = _____ ml

Estimated Particulate Collection

M_n = C x V_m x $530/(T_m x 35.3)$ = _____ grams

KVB, Inc. Trace Species and Organics Sampling Data

Project: EPA PHASE III SASS Personnel: PIONEER KAGERTY Barometric Press: 29.89

Date: 9-19-77

Location: 15 400 KW BASELINE

Unit: 4 Probe Nozzle Diameter (inches): 1/2 (Dn)

Test: 15-10 Absolute Static Press. in Stack (in. Hg): .07 (Ps)

Fuel: #2 OIL Pitot Tube Coefficient: _____ (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In	Meter Out	
0950	0	6"	.35	2.44	612.3037	6.5	417	375	48	54	380	62	62	
1005	15	6	.30	2.05	644.0000	6.4	418	390	65	68	402	71	63	
1035	45	6	.30	2.05	706.0000	6.8	415	401	64	64	404	80	65	
1105	75	6	.30	2.05	768.0000	7.2	418	402	65	63	405	84	74	
1135	105	6	.30	2.05	834.0000	7.5	405	400	68	60	405	89	78	
1220	150	6	.30	2.05	923.4022	7.9	CHANGE DESSICANT							
1225	150	6	.30	2.05	923.4022	8.2	414	401	68	65	408	81	79	
1325	210	6	.30	2.05	046.7000	9.0	420	403	67	65	407	87	79	
1425	270	6	.30	2.05	171.0000	9.8	404	401	66	60	406	87	80	
1455	300	6	.30	2.05	234.3037	10.2	411	402	68	63	407	90	80	

KVB, Inc. Trace Species and Organics Sampling Data

Project: EPA PHASE III SASS Personnel: PIONESSA Barometric Press: 30.14

Date: 4-21-77 400 Kw BASELINE

Location: 15

Unit: Probe Nozzle Diameter (inches): 1/2" (Dn)

Test: 15-11 Absolute Static Press. in Stack (in. Hg): -.065 (Ps)

Fuel: #2 OIL Pitot Tube Coefficient: .83 (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In	Meter Out	
0925	0	6"	.30	2.05	236.6000	5.9	422	398	67	75	412	74	66	
0855	30	6"	.35	2.2	298.4000	6.2	419	396	61	65	411	86	71	
0925	60	6"	.35	2.2	361.9000	6.8	420	392	57	62	406	88	76	
0955	90													
1025	120	6"	.35	2.2	427.0000	7.8	415	397	59	58	404	92	80	
1055	150	6"	.35	2.2	550.4028	8.3	419	398	60	58	405	93	81	
				CHANGED		DESSICANT								
1056	150	6"	.35	2.2	550.4028	8.5	404	399	56	53	407	90	81	
1156	210	6"	.35	2.2	677.0000	9.6	412	397	63	71	412	92	82	
1256	270	6"	.35	2.2	801.3000	10.5	409	396	64	65	406	90	82	
1326	300	6"	.35	2.2	864.8862	11.0	418	394	63	63	416	92	83	

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 15-10 Date 4-19-77 Location 15 DIESEL ENGINE

Sample Port Position STACK

Container Number	Sample Description	Container Type	Net wt/vol.	Comment	AA	GC
563	S P+N+10% SOLIDS	4oz NAL	0.0038g	DO AA AFTER 6SH6	Y	NO
NONE	3% HP 1% SOLIDS					
541	S #1 FILTER	PETRI	0.2555g	DUP	YY	Y
899	L PN 10% 50/50 WASH	16oz A	345ml		↑	NO
935	L PN 10% H_2O WASH	"	246ml			↓
889	L 3% 50/50 WASH	8oz A	165ml			
888	L 3% H_2O WASH	"	178ml.	WASTE		
890	L 1% 50/50 WASH	"	164ml	DUP	YY	
900	L 1% H_2O WASH	"	114ml.			
887	L FILT. HOUSING WASH 50/50	"	103ml			
901	L " H_2O	"	72ml		↓	↓
898	L XAD MODULE WASH	16oz A	398ml	DUP	YY	YY DUP
1041	S XAD RESIN	16oz AWM	150g	430-280 DUP	YY	YY DUP
700	L XAD CONDENSATE	1l NAL	673ml		↓	↑
699 B1	L IMPINGER #1 SOLN	1l NAL	825ml	BLEED		
936	L IMPINGER #1 RINSE	16oz A	236ml	3877ml	↓	NO
692	L IMP #2 SOLN	1l NAL	761ml	885 RINSE		
937	L " RINSE	16oz A	340ml			
690	L IMP #3 SOLN	1l NAL	733ml			
938	L " RINSE	16oz A	308ml		↓	↓
1042	LF DIESEL FUEL	GLASS		861g Total	Y	Y
1043	SB XAD BLANK	16oz AWM	103g		Y	NO
543	SB FILTER BLANK	PETRI	—		Y	
709	LB IMP #1 BLANK	1l N	1000ml		Y	
701	LB IMP #2 & 3 BLANK	1l N	1085ml		Y	
706	LB H_2O BLANK	"	579ml		Y	
704	LB 50/50 BLANK	"	962ml		Y	
703	LB IPA BLANK	"	965ml	DUP	Y	↓

COUNT S-3 L-5
SB-2 LF-1
SD-2/7 LB-5
LD-2/11

18 ANALYSIS SEE DATA SHEET KVB 6002-15
27 BOTTLES.

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 15-10 Date 4-19-77 Location 15 DIESEL ENGINE

Sample Port Position STACK

SSMS FOR TEST 15-10

Container Number	Sample Description	Container Type	Net wt/vol.	Comment
D			0.0082	100% NOT ENOUGH
A' A	L COMPOSITE OF B (SOLIDS WASH)		1407ml	100%
E 541	S FILTER			100%
F 1041	S XAD	1	150g	100%
G 898	L XAD MOD RINSE		398ml	-9%
B	L COMPOSITE OF 7 700,699,956,692,987,690,988		3877ml	[illegible] -91%
H 1042	L FUEL		867g	
SS	COUNT S-3			
	L-3			

Data Sheet KVB 6002-15

DIESEL ENGINE

TEST 15-10 TABLE STACK

POLLUTANT	SAMPLE NUMBER							
	563+	541+	541+ duplicate	A*	A* duplicate	898*	898* duplicate	1041+
Antimony	ENTIRE SAMPLE SENT TO CTE	<200	<200	<0.5	<0.5	<0.5	<0.5	<23
Arsenic		<8.0	<8.0	<0.005	0.012	0.020	0.020	4.6
Barium		<80	920	<0.1	<0.1	<0.1	<0.1	9.3
Beryllium		<4.0	<4.0	<0.005	<0.005	<0.005	<0.005	0.46
Cadmium		<4.0	<4.0	<0.005	<0.005	0.030	0.030	0.46
Calcium		68000	72000	1.0	0.95	0.15	0.16	4.6
Chromium		64	52	0.04	0.11	2.0	2.0	3.2
Cobalt		32	60	<0.2	<0.2	<0.2	<0.2	1.4
Copper		20	32	<0.02	<0.02	0.10	0.10	4.2
Iron		1300	1000	0.61	0.64	3.3	3.4	25
Lead		<40	<40	<0.05	<0.05	<0.05	<0.05	<2.3
Manganese		40	36	0.12	0.11	0.09	0.08	1.4
Mercury		<0.16	<0.16	<0.005	<0.005	<0.005	<0.005	<0.02
Nickel		20	20	0.47	0.42	0.51	0.56	2.3
Selenium		16	<8	<0.010	<0.010	0.050	0.070	1.9
Tellurium		<200	<200	<0.3	<0.3	<0.3	<0.3	<23
Tin		<400	<400	<1	<1	<1	<1	<46
Titanium		<1200	<1200	<1	<1	<1	<1	<140
Vanadium		<80	<80	<0.1	<0.1	<0.1	<0.1	<9.3
Zinc		670	620	0.32	0.25	0.29	0.24	4.6
Chloride		—	—	1.6	<0.5	0.54	<0.5	52.1
Fluoride		<5	—	<0.1	<0.1	0.21	0.19	12
Nitrates		—	—	0.20	0.36	0.16	0.08	55.8
Sulfates		—	—	2.0	6.0	19.0	28.0	89.8

*μg/g
*μg/ml

899,935,
889,888,
890,900,
887,901

DIESEL ENGINE

TEST 15-10 TABLE STACK

POLLUTANT	SAMPLE NUMBER							
	1041+ duplicate	B_1*	B*	1042+ µg/sample	1043+	543+	709*	701*
Antimony	<22		<0.5	<25	<28	<100	<0.5	<0.5
Arsenic	3.5		0.010	<2	4.5	16	<0.005	<0.005
Barium	<8.7		<0.1	30	22	280	<0.1	<0.1
Beryllium	<0.43		<0.005	<0.3	<0.56	<2.0	<0.005	<0.005
Cadmium	<0.43		0.015	<0.3	0.56	2.0	<0.005	0.010
Calcium	4.3		0.50	30	11	170000	0.15	0.26
Chromium	3.5		0.39	<5	12	30	0.02	<0.02
Cobalt	1.7		<0.2	<10	3.4	24	<0.2	<0.2
Copper	0.87		0.04	<3	1.1	12	0.05	0.04
Iron	18		1.6	<5	20	1000	0.53	0.15
Lead	<2.2		<0.05	<5	<2.8	<10	17	0.09
Manganese	0.87		0.07	1.0	1.1	34	<0.01	0.02
Mercury	<0.02		<0.005	<0.1	<0.02	<0.08	<0.005	<0.005
Nickel	<2.2		0.23	<1	<2.8	<10	<0.05	<0.05
Selenium	2.6		0.020	<1	<1.1	<4	<0.010	<0.010
Tellurium	<22		<0.3	<25	<28	<100	<0.3	<0.3
Tin	<43		<1	<25	<56	<200	2.7	<1
Titanium	<130		<1	<250	<168	<600	<1	<1
Vanadium	<8.7		<0.1	<5	<1.1	<40	<0.1	<0.1
Zinc	1.7		0.21	10	2.2	30	0.19	0.16
Chloride	53.9	—	21.8	<10	<11	2552	<0.5	97.4
Fluoride	32	—	0.28	12.5	59.0	4880	0.20	<0.1
Nitrates	59.7	0.16	—	1.95	1.20	18.0	0.46	0.84
Sulfates	49.7	2950	—	44.3	<50	600	2.0	33000
		700, 699, 936	700, 699, 936, 692, 937, 690, 938					

1 µg/paper

* filter paper blank

DIESEL ENGINE

TEST 15-10			TABLE	STACK				
POLLUTANT	SAMPLE NUMBER							
	706*	704*	703*	703* Dup.				
Antimony	<0.5	<0.5	<0.5	<0.5				
Arsenic	<0.005	<0.005	<0.005	<0.005				
Barium	<0.1	<0.1	<0.1	<0.1				
Beryllium	<0.005	<0.005	<0.005	<0.005				
Cadmium	<0.005	<0.005	<0.005	<0.005				
Calcium	0.05	0.07	0.23	0.12				
Chromium	0.02	<0.02	<0.02	<0.02				
Cobalt	<0.2	<0.2	<0.2	<0.2				
Copper	<0.02	<0.02	<0.02	<0.02				
Iron	0.32	0.14	0.15	0.19				
Lead	<0.05	<0.05	<0.05	<0.05				
Manganese	<0.01	<0.01	0.01	0.01				
Mercury	<0.005	<0.005	<0.005	<0.005				
Nickel	<0.05	<0.05	<0.05	<0.05				
Selenium	<0.010	<0.010	<0.010	<0.010				
Tellurium	<0.3	<0.3	<0.3	<0.3				
Tin	<1	<1	<1	<1				
Titanium	<1	<1	<1	<1				
Vanadium	<0.1	<0.1	<0.1	<0.1				
Zinc	0.18	0.16	0.20	0.27				
Chloride	<0.5	<0.5	<0.5	—				
Fluoride	<0.1	<0.1	<0.1	—				
Nitrates	0.06	0.10	0.24	—				
Sulfates	4.0	<2	<2	—				

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 750-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

To: Mr. John C. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: July 6, 1977

Analyst: S. Sweeney

P. O. No.:

Sample No.: Test 15-10 Al

IAD No.: 97-A345-134-21

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.2	Terbium		Ruthenium		Vanadium	0.3
Thorium	≤0.2	Gadolinium		Molybdenum	0.7	Titanium	0.2
Bismuth		Europium		Niobium		Scandium	≤0.01
Lead	0.7	Samarium		Zirconium	0.1	Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	5
Mercury	NR	Praseodymium	0.02	Strontium	0.9	Chlorine	1
Gold	≤0.02	Cerium	0.04	Rubidium	0.007	Sulfur	MC
Platinum		Lanthanum	0.07	Bromine	0.07	Phosphorus	MC
Iridium		Barium	0.8	Selenium	0.08	Silicon	3
Osmium		Cesium	0.03	Arsenic	0.03	Aluminum	0.4
Rhenium		Iodine	0.04	Germanium		Magnesium	5
Tungsten		Tellurium		Gallium	≤0.01	Sodium	MC
Tantalum		Antimony	0.04	Zinc	0.5	Fluorine	≈1
Hafnium		Tin		Copper	0.3	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.7	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.03	Carbon	NR
Thulium		Silver	3	Iron	5	Boron	0.04
Erbium		Palladium		Manganese	0.04	Beryllium	
Holmium		Rhodium		Chromium	0.2	Lithium	≤0.001
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.02 µg/ml

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 230 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-9494
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14200 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9321

To: Mr. John C. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: July 1, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: Test 15-10 E 541 5/27/77

IAD No.: 97-A345-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	11	Terbium		Ruthenium		Vanadium	27
Thorium	2	Gadolinium		Molybdenum	16	Titanium	41
Bismuth	0.4	Europium		Niobium	0.3	Scandium	≤0.2
Lead	200	Samarium		Zirconium	20	Calcium	MC
Thallium		Neodymium	0.3	Yttrium	1	Potassium	MC
Mercury	NR	Praseodymium	0.2	Strontium	300	Chlorine	180
Gold		Cerium	1	Rubidium	1	Sulfur	870
Platinum		Lanthanum	1	Bromine	5	Phosphorus	MC
Iridium		Barium	150	Selenium	2	Silicon	MC
Osmium		Cesium	0.2	Arsenic	6	Aluminum	>140
Rhenium		Iodine	2	Germanium	≤0.1	Magnesium	MC
Tungsten	6	Tellurium		Gallium	1	Sodium	>360
Tantalum		Antimony	0.5	Zinc	MC	Fluorine	MC
Hafnium		Tin	13	Copper	130	Oxygen	NR
Lutetium		Indium	STD	Nickel	47	Nitrogen	NR
Ytterbium		Cadmium	1	Cobalt	21	Carbon	NR
Thulium		Silver	24	Iron	270	Boron	880
Erbium		Palladium		Manganese	14	Beryllium	<0.1
Holmium		Rhodium		Chromium	64	Lithium	0.5
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.1 ppm weight

Approved: M Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 888 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 738-8484

Reply to INSTRUMENTAL ANALYSIS DIVISION, 14333 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE 303-278-9321

To: Mr. John C. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: July 1, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: Test 15-10 F 1041 5/27

IAD No.: 97-A345-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.9	Terbium		Ruthenium		Vanadium	<0.1
Thorium		Gadolinium		Molybdenum	6	Titanium	0.7
Bismuth		Europium		Niobium		Scandium	<0.1
Lead	≤0.5	Samarium		Zirconium	2	Calcium	8
Thallium		Neodymium		Yttrium		Potassium	20
Mercury	NR	Praseodymium		Strontium	<0.1	Chlorine	7
Gold		Cerium		Rubidium		Sulfur	27
Platinum		Lanthanum		Bromine	0.5	Phosphorus	10
Iridium		Barium	0.6	Selenium		Silicon	10
Osmium		Cesium		Arsenic	<0.1	Aluminum	3
Rhenium		Iodine	0.2	Germanium		Magnesium	12
Tungsten		Tellurium		Gallium	<0.1	Sodium	≥330
Tantalum		Antimony		Zinc	2	Fluorine	≈5
Hafnium		Tin	≤0.2	Copper	1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.8	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	<0.1	Carbon	NR
Thulium		Silver	0.1	Iron	2	Boron	0.5
Erbium		Palladium		Manganese	<0.1	Beryllium	
Holmium		Rhodium		Chromium	0.6	Lithium	0.1
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.1 ppm weight

Approved:

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucib

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 330 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-6464
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14333 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-6621

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: July 5, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: Test 15-10 G Comp. of 898 + B 700, 699, 936, 692, 937, 690, 938 5/27/77

IAD No.: 97-A345-134-21

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.04	Terbium		Ruthenium		Vanadium	0.02
Thorium	≤0.03	Gadolinium		Molybdenum	0.2	Titanium	0.5
Bismuth		Europium	0.004	Niobium	0.004	Scandium	≤0.004
Lead	*0.2	Samarium	0.01	Zirconium	0.02	Calcium	MC
Thallium		Neodymium	0.01	Yttrium	0.003	Potassium	9
Mercury	NR	Praseodymium	0.006	Strontium	0.2	Chlorine	0.2
Gold		Cerium	0.007	Rubidium	0.001	Sulfur	MC
Platinum		Lanthanum	0.04	Bromine	≤0.007	Phosphorus	MC
Iridium		Barium	0.03	Selenium	≤0.01	Silicon	0.4
Osmium		Cesium	0.005	Arsenic	0.03	Aluminum	>4
Rhenium		Iodine	0.007	Germanium	≤0.002	Magnesium	MC
Tungsten		Tellurium		Gallium	0.004	Sodium	MC
Tantalum		Antimony	0.009	Zinc	0.5	Fluorine	≈0.2
Hafnium		Tin	≤0.008	Copper	0.09	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.2	Nitrogen	NR
Ytterbium		Cadmium	0.006	Cobalt	0.01	Carbon	NR
Thulium		Silver	MC	Iron	7	Boron	0.002
Erbium		Palladium		Manganese	0.04	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.3	Lithium	0.01
Dysprosium						Hydrogen	NR

*Heterogeneous
NR – Not Reported
All elements not reported <0.003 µg/ml

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 888 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 738-8434

Reply to INSTRUMENTAL ANALYSIS DIVISION, 14033 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9221

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: July 1, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: Test 15-10 H 1042 LF Diesel Fuel 5/27/77 IAD No.: 97-A345-134-21

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.06	Terbium		Ruthenium		Vanadium	*0.003
Thorium	0.05	Gadolinium		Molybdenum	0.1	Titanium	0.05
Bismuth		Europium		Niobium		Scandium	≤0.001
Lead	0.06	Samarium		Zirconium	0.07	Calcium	1
Thallium		Neodymium		Yttrium		Potassium	0.7
Mercury	NR	Praseodymium		Strontium	0.01	Chlorine	0.3
Gold	≤0.006	Cerium	0.01	Rubidium	0.001	Sulfur	1
Platinum		Lanthanum	0.01	Bromine	0.02	Phosphorus	0.2
Iridium		Barium	0.07	Selenium	≤0.01	Silicon	0.4
Osmium		Cesium	≤0.002	Arsenic	0.008	Aluminum	0.06
Rhenium		Iodine	0.009	Germanium		Magnesium	0.2
Tungsten		Tellurium		Gallium	0.003	Sodium	0.4
Tantalum		Antimony	0.009	Zinc	0.4	Fluorine	*0.4
Hafnium		Tin		Copper	0.08	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium	≤0.008	Cobalt	0.002	Carbon	NR
Thulium		Silver	0.02	Iron	0.1	Boron	0.02
Erbium		Palladium		Manganese	0.005	Beryllium	
Holmium		Rhodium		Chromium	0.01	Lithium	<0.001
Dysprosium						Hydrogen	NR

*Heterogeneous
NR – Not Reported
All elements not reported < 0.004 µg/ml

Approved:

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucible prior to analysis.

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 15-11 Date 4/21/77 Location 15 DIESEL ENGINE

Sample Port Position STACK

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment	AA	GC
	NONE	PN 10μ, 3μ, 1μ BLANKS					
	542	S & FILTER	PETRI	0.2366g		Y	Y
A *	940	L PN 10μ WASH 50/50	16oz A	368ml	1416ml		
	942	L " H_2O	"	318ml			
	909	L 3μ WASH 50/50	8oz A	211ml			
	910	L " H_2O	"	137ml			
	904	L 1μ WASH 50/50	"	97ml		Y	NO
	916	L " H_2O	"	92ml			
	903	L FILT. HOUS. WASH 50/50	"	93ml			
	915	L " H_2O	"	100ml			
	941	L XAD MOD WASH	16oz A	402ml		Y	Y
	1044	S XAD RESIN	16oz AWM	154g	434-280	Y	Y
B *	691 B1	L XAD CONDENSATE	1l N	671ml	bulged		
	693	L IMP #1 SOL'N	1l N	876ml			
	943	L IMP #1 RINSE	16oz A	329ml	4062ml		NO
	705	L IMP #2 SOL'N	1l N	792ml		Y	
	944	L IMP #2 RINSE	16oz A	339ml			
	711	L IMP #3 SOL'N	1l N	756ml			
	945	L IMP #3 RINSE	16oz A	299ml			
	1045	LF DIESEL FUEL	GLASS	868g/ml		Y	Y
	COUNT	S-2 L-3					
		LF-1					
		4					
		6 ANALYSES					
		19 BOTTLES					

Data Sheet KVB 6002-15

DIESEL ENGINE

TEST 15-11 TABLE STACK

POLLUTANT	SAMPLE NUMBER							
	542+	A*	941*	1044+	B_1*	B*	1045+	
Antimony	<100	<0.5	<0.5	<23		<0.5	<25	
Arsenic	<16	<0.005	0.010	10		<0.005	<2	
Barium	<280	<0.1	<0.1	123		<0.1	<5	
Beryllium	<2	<0.005	<0.005	<0.46		<0.005	<0.3	
Cadmium	<2	<0.005	0.030	<0.46		0.010	<0.3	
Calcium	<60000	0.81	0.17	<4.6		0.48	30	
Chromium	25.4	0.02	0.82	5.0		0.12	<5	
Cobalt	16.9	<0.2	<0.2	4.1		<0.2	<10	
Copper	33.8	<0.02	0.04	3.2		<0.02	<3	
Iron	<1000	0.37	1.6	6.7		0.50	<5	
Lead	<10	<0.05	<0.05	—		<0.05	<5	
Manganese	<34	0.03	0.04	0.91		0.02	0.3	
Mercury	<0.08	<0.005	<0.005	<0.02		<0.005	<0.1	
Nickel	<10	0.11	0.25	<2.3		0.10	<1	
Selenium	<4	<0.010	0.040	<0.91		0.020	<1	
Tellurium	<100	<0.3	<0.3	<23		<0.3	<25	
Tin	<200	<1	<1	<46		<1	<25	
Titanium	<600	<1	<1	<137		<1	<250	
Vanadium	<40	<0.1	<0.1	<9.1		<0.1	<5	
Zinc	2710	0.35	0.14	0.91		0.17	<0.5	
Chloride	—	0.54	0.54	<11	——	71.8	<9	
Fluoride	—	<0.1	<0.1	23.0	——	0.21	13.6	
Nitrates	—	0.06	0.12	2.65	0.12	——	7.84	
Sulfates	—	4.0	5.2	<50	2850	——	48.0	
		940,942, 909,910, 904,916, 903,915			691,693, 943	691,693, 943,705, 944,711, 945		

KVB Analysis Data

Test	Sample Number	POM's	PCB's
12/2-3	298	< 1 ug/g	< 1 ug/g
12/2-6	534	< 1 ug/g	< 1 ug/g
	534 (duplicate)	< 1 ug/g	< 1 ug/g
13-18	740	90 ug/g	< 1 ug/g
13-18	282	49 ug/g	< 1 ug/g
13-18	530	3.2 ug/g	< 1 ug/g
13-18	1038	6.3 ug/g	< 1 ug/g
13-18	1032	396 ug/g	< 1 ug/g
13-18	1033	1 ug/g	< 1 ug/g
13-18	1034	8 ug/g	< 1 ug/g
13-18	1034 (duplicate)	9 ug/g	< 1 ug/g
13-24	735	513 ug/g	< 1 ug/g
	531	6.9 ug/g	< 1 ug/g
	1039	20 ug/g	< 1 ug/g
	1035	144 ug/g	< 1 ug/g
	1036	10 ug/g	< 1 ug/g
	1037	7.1 ug/g	< 1 ug/g
	1037 (duplicate)	8.5 ug/g	< 1 ug/g
14	556	70.5 ug/g	< 1 ug/g
	568	104 ug/g	< 1 ug/g
	532	10.7 ug/g	< 1 ug/g
	532 (duplicate)	8.2 ug/g	< 1 ug/g
15-10	1041	< 0.1 ug/g	< 1 ug/g
	1041 (duplicate)	< 0.1 ug/g	< 1 ug/g
	1042	*	*
15-11	941	< 1 ug/l	< 1 ug/l
	1044	< 0.1 ug/g	< 1 ug/g
	1045	*	*
19-1	LF	*	*
19-2	533	< 0.1 ug/g	< 1 ug/g
	533 (duplicate)	< 0.1 ug/g	< 1 ug/g
	C	< 1 ug/l	< 1 ug/l
	C (duplicate)	< 1 ug/l	< 1 ug/l
	LF	*	*

*Sample extracts too concentrated to be able to determine an analytical value.

STEEL BILLET REHEAT FURNACE

Location No. 16 Unit No. 1

Unit Description STEEL BILLET REHEAT FURNACE

Installation Date

Heater Rating 35 MW (117 x 10^6 Btu/hr)

Burner Description NORTH AMERICAN 112-17

13 DUAL FUEL IN TOP FIRING (HEATING) ZONE AND 4 IN BOTTOM SOAKING ZONE

Test Fuel Combinations NAT. GAS

Fuel Temp. at Burner (°F) AMBIENT

Primary Air Temp. (°F) AMBIENT

Comments:

MOBILE LABORATORY DATA Test No._____

Test No. 16/1-1 Date 5/3/77 Location 16 Engr. WAC

Unit No._____ Fuel NAT. GAS Capacity_____

Unit Type 10" REHEAT FURNACE Burner Type No. American 112-17

1. Test No.	16/1-1		16/1-2		16/1-3		16/1-4		16/1-5	
2. Date	5-3-77		5-3-77		5-3-77		5-3-77		5-3-77	
3. Time	1045		11:15 A		12:45		1:45 P		2:15 P	
4. Load										
5. Process Rate, BILLETS/HR	60		60		60					
6. Flue Diam. or Size, ~~ft~~ in.	58		—						→	
7. Probe Position, in. in	29 in		—						→	
8. Oxygen (%)	16.1		15.5		16.2		15.6		15.7	
9. NOx (hot) read/3% O_2 (ppm)	21	77	24	78	22	82	25	83	23	78
10. NO (hot) read/3% O_2 (ppm)	19	70	22	72	20	75	23	77	22	75
11. NO_2 (hot) read/3% O_2 (ppm)										
12. NO (cold) read/3% O_2 (ppm)	20	73	24	78	22	82	24	80	24	82
13. Carbon Dioxide (%)										
14. Carbon Monoxide (ppm) uncor/cor	8	29	10	33	12	45	12	40	8	27
15. Hydrocarbon (ppm) uncor/cor										
16. Sulfur Dioxide (ppm) uncor/cor	0	0	0	0	0	0	0	0	0	0
17. Smoke Spot (Bacharach)	—		—		—					
18. Atmos. Temp. (°F/°C)	69		69		71		74		75	
19. Dew Point Temp. (°F/°C)	60		60		61		64		64	
20. Atmos. Pressure (in. Hg)	30.45									
21. Relative Humidity (%)	61		61		58		59		56	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 16/1 Date 5-4-77 Location #16 Engr. WAC

Unit No. _____ Fuel NAT. GAS Capacity _____

Unit Type 10" REHEAT FURNACE Burner Type NO. AMERICAN MDL #112-17

1. Test No.	16/1-6		16/1-7		16/1-8		16/1-9		16/1-10	
2. Date	5-4-77		5-4-77		5-4-77		5-4-77		5-4	
3. Time	0845		0930		10:00		11:00		13:15	
4. Load										
5. Process Rate, BILLETS/HR			76		96		121		81	
6. Flue Diam. or Size, ft	58 in.		———		———		———		——→	
7. Probe Position	29 in.		———		———		———		——→	
8. Oxygen (%)	15.8		15.8		15.6		13.9		14.5	
9. NOx (hot) read/3% O_2 (ppm)	19	66	20	69	21	70	30	76	27	75
10. NO (hot) read/3% O_2 (ppm)	18	62	18	62	19	63	28	71	26	72
11. NO_2 (hot) read/3% O_2 (ppm)										
12. NO (cold) read/3% O_2 (ppm)	20	69	19	66	21	70	30	76	27	75
13. Carbon Dioxide (%)										
14. Carbon Monoxide (ppm) uncor/cor	4	14	8	28	8	27	8	20	7	19
15. Hydrocarbon (ppm) uncor/cor										
16. Sulfur Dioxide (ppm) uncor/cor	0	0	0	0	0	0	0	0	0	0
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	65		70		68		71		74	
19. Dew Point Temp. (°F/°C)	59		62		60		61		62	
20. Atmos. Pressure (in. Hg)	30.01		30.01		30.01		30.01		30.01	
21. Relative Humidity (%)	70		64		64		58		52	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 16/1 Date 5-3-77 Location 16 Engr. WAC

Unit No. _____ Fuel N.G. Capacity _____

Unit Type 10" REHEAT FURNACE Burner Type N.A. MDL #112-17

1. Test No.	16/1-11											
2. Date	5-4-77											
3. Time	2:30 P											
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft	58"											
7. Probe Position	29											
8. Oxygen (%)	15.0											
9. NOx (hot) read/3% O_2 (ppm)	27	81										
10. NO (hot) read/3% O_2 (ppm)	26	78										
11. NO_2 (hot) read/3% O_2 (ppm)												
12. NO (cold) read/3% O_2 (ppm)	27	81										
13. Carbon Dioxide (%)												
14. Carbon Monoxide (ppm) uncor/cor	16	18										
15. Hydrocarbon (ppm) uncor/cor												
16. Sulfur Dioxide (ppm) uncor/cor	0											
17. Smoke Spot (Bacharach)	—											
18. Atmos. Temp. (°F/°C)												
19. Dew Point Temp. (°F/°C)												
20. Atmos. Pressure (in. Hg)	29.95											
21. Relative Humidity (%)												
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 16/1 Date 5-5-77 Location 16 Engr. WC/MBH

Unit No. _____ Fuel NAT. GAS Capacity _____

Unit Type RE-HEAT FURNACE Burner Type _____

1. Test No.	16/1-12		16/1-12		16/1-12		16/1-12		16/1-13	
2. Date	5-5-77		5-5-77				5-5-77		5-5	
3. Time	0930		1045				1230		1:00 P	
4. Load										
5. Process Rate BILLETS/HR							175			
6. Flue Diam. or Size, ft	58"		———		———		———		———	
7. Probe Position	29"		———		———		———		———	
8. Oxygen (%)	13.0		13.1		13.1		14.2		14.0	
9. NOx (hot) read/3% O_2 (ppm)	26	59	30	68	29	66	31	82	34	87
10. NO (hot) read/3% O_2 (ppm)	23	52	28	64	27	62	30	79	33	85
11. NO_2 (hot) read/3% O_2 (ppm)	3	7	2	4	2	4				
12. NO (cold) read/3% O_2 (ppm)	21	47	29	66	28	64	31	82	32	82
13. Carbon Dioxide (%)										
14. Carbon Monoxide (ppm) uncor/cor	14	32	14	32	14	32	35	93	30	77
15. Hydrocarbon (ppm) uncor/cor										
16. Sulfur Dioxide (ppm) uncor/cor	0	0	0	0	0	0	0	0	0	0
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	65		67		66		70			
19. Dew Point Temp. (°F/°C)	59		59		60		60			
20. Atmos. Pressure (in. Hg)	29.95		29.95		29.95		29.95		29.95	
21. Relative Humidity (%)	70		62		70		56			
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 16/1 Date 5-5-77 Location 16 Engr._____

Unit No._____ Fuel N. G. Capacity_____

Unit Type 10" REHEAT FURN Burner Type_____

1. Test No.	16/1-14		16/1-15		16/1-16		16/1-17			
2. Date	5-5-77									
3. Time	1322		1330		1340		1440			
4. Load										
5. Process Rate	175/hr		175/hr		175/					
6. Flue Diam. or Size, ft	58"		58		58		58			
7. Probe Position	29		29		29		29			
8. Oxygen (%)	13.5		13.7		13.5		14.5			
9. NOx (hot) read/3% O_2 (ppm)	27	65	24	59	25	60	38	105		
10. NO (hot) read/3% O_2 (ppm)	25	60	23	57	23	55	35	97		
11. NO_2 (hot) read/3% O_2 (ppm)										
12. NO (cold) read/3% O_2 (ppm)	27	65	25	62	24	58	37	102		
13. Carbon Dioxide (%)										
14. Carbon Monoxide (ppm) uncor/cor	40	96	42	104	40	96	30	83		
15. Hydrocarbon (ppm) uncor/cor										
16. Sulfur Dioxide (ppm) uncor/cor	0	0	0	0	0	0	0	0		
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)							68			
19. Dew Point Temp. (°F/°C)							60			
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)							63			
22. BURNERS OUT OF SERVICE	6+8		5,7,9		4,7,10		BASELINE			
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 16/1 Date 5-6-77 Location 16 Engr._____

Unit No._____ Fuel NAT GAS Capacity_____

Unit Type 10" REHEAT FURNACE Burner Type NO. AMER. 112-17

1. Test No.	16/1-18		→		→						
2. Date	5-6-77		5-6-77								
3. Time	10:00 A		11:05		12:00						
4. Load											
5. Process Rate, BILLETS/hr					140						
6. Flue Diam. or Size, ft											
7. Probe Position											
8. Oxygen (%)	14.3		13.2		13.0						
9. NOx (hot) read/3% O_2 (ppm)	33	89	29	67	30	68					
10. NO (hot) read/3% O_2 (ppm)	31	83	27	62	29	65					
11. NO_2 (hot) read/3% O_2 (ppm)											
12. NO (cold) read/3% O_2 (ppm)	32	86	29	67	30	68					
13. Carbon Dioxide (%)											
14. Carbon Monoxide (ppm) uncor/cor	36	97	33	76	50	112					
15. Hydrocarbon (ppm) uncor/cor											
16. Sulfur Dioxide (ppm) uncor/cor	0		0		0						
17. Smoke Spot (Bacharach)											
18. Atmos. Temp. (°F/°C)	65		65		65						
19. Dew Point Temp. (°F/°C)	56		55		55						
20. Atmos. Pressure (in. Hg)	29.91		29.90		29.90						
21. Relative Humidity (%)	56		52		52						
22.											
23.											
24.											
25.											
26.											
27.											
28.											
29.											
30.											

Data Sheet 6002-2

OPERATING DATA

Location 16

Unit 1

10 inch Reheat Furnace

Test No.	16/1-1	16/1-2	16/1-3	16/1-4	16/1-5
Date	5-3	5-3	5-3	5-3	5-3
Time	10:45	11:15	12:45	13:45	14:20
Soak Zone, °F	2100	2080	2100	2100	2100
Top Zone, °F	1800	1800	1800	1800	1800
Soak Zone Air Flow, CFH	14,200	15,600	15,600	14,500	14,000
Soak Zone Gas Flow, CFH	8100	9100	9400	8500	8100
Air Fuel Ratio Setpoint	0	0	0	0	0
Heating Zone Air Flow, CFH	64000	70 000	68000	63000	62000
Heating Zone Gas Flow, CFH	39000	45000	43000	39000	37000
Air Fuel Ratio Setpoint	11	11	11	11	11
Furnace Press. Setpt., in. H_2O	+.073	+.073	+.073	+.073	+.073
Fuel Flow Integrator	973080	973145	973456	973768	973779
BOOS (BURNERS OUT OF SERVICE)	NONE	NONE	NONE	NONE	NONE
Load (billets per hour)	~60	~60	~60	—	—
Billet Counter					

BASELINE →

OPERATING DATA

Location 16

Unit 1

10 inch Reheat Furnace

Test No.	16/1-6	16/1-7	16/1-8	16/1-9	16/1-10
Date	5-4-77	5-4	5-4	5-4	5-4
Time	8:45	9:30	10:00	11:00	13:15
Soak Zone, °F	2120	2100	2110	2122	2122
Top Zone, °F	1800	1800	1800	1835	1820
Soak Zone Air Flow, CFH	15300	14300	15100	16400	15500
Soak Zone Gas Flow, CFH	9300	8300	9100	10000	9500
Air Fuel Ratio Setpoint	0	0	0	0	0
Heating Zone Air Flow, CFH	64000	65000	64000	78000	70000
Heating Zone Gas Flow, CFH	42000	40000	42000	52000	44000
Air Fuel Ratio Setpoint	11	11	11	11	11
Furnace Press. Setpt., in. H_2O	+.073	+.073	+.073	+.073	+.073
Fuel Flow Integrator	977296	977442	977545	977865	978365
BOOS	NONE	NONE	NONE	NONE	NONE
Load (billets per hour)					
Billet Counter		265	313	434	617

BASELINE
SO_x

OPERATING DATA

Location 16

Unit 1

10 inch Reheat Furnace

Test No.	16/1-11				
Date	5-4				
Time	14:30				
Soak Zone, °F	2140				
Top Zone, °F	1820				
Soak Zone Air Flow, CFH	14400				
Soak Zone Gas Flow, CFH	8600				
Air Fuel Ratio Setpoint	0				
Heating Zone Air Flow, CFH	65000				
Heating Zone Gas Flow, CFH	39500				
Air Fuel Ratio Setpoint	+11				
Furnace Press. Setpt., in. H_2O	+.073				
Fuel Flow Integrator	978645				
BCOS	NONE				
Load (billets per hour)					
Billet Counter					

OPERATING DATA

Location 16

Unit 1

10 inch Reheat Furnace

Test No.	16/1-12	16/1-12	16/1-12	16/1-12	16/1-13
Date	5-5-77	5-5	5-5-77	5-5-77	5-5
Time	0930	1045 A	1135	12:30	13:00
Soak Zone, °F	2230	2160	2230	2225	2220
Top Zone, °F	2040	2060	2040	2080	2040
Soak Zone Air Flow, CFH	17000	19000	15800	11200	8400
Soak Zone Gas Flow, CFH	11800	12700	10200	6400	5000
Air Fuel Ratio Setpoint	7.0	7	7	7	-15
Heating Zone Air Flow, CFH	104000	100000	103000	103000	98000
Heating Zone Gas Flow, CFH	86000	82000	80000	77000	75000
Air Fuel Ratio Setpoint	11	11	11	11	-1
Furnace Press. Setpt., in. H_2O	+.08	.08	.08	+.08	+.08
Fuel Flow Integrator	984253	984802	985150	985547	985752
BOOS	0	0	0	0	0
Load (billets per hour)					
Billet Counter					

PARTIC. TEST → LOW AIR

OPERATING DATA

Location 16

Unit 1

10 inch Reheat Furnace

Test No.	16/1-14	16/1-15	16/1-16	16/1-17	
Date	5-5	5-5	5-5	5-5	
Time	13:25	13:35	13:42	14:45	
Soak Zone, °F	2240	2255	2265	2260	
Top Zone, °F	2045	2040	2040	2170	
Soak Zone Air Flow, CFH	15900	14500	14500	4100	
Soak Zone Gas Flow, CFH	10100	9100	9500	1000	
Air Fuel Ratio Setpoint	-6	-6	-6	-4	
Heating Zone Air Flow, CFH	103500	103500	103500	103500	
Heating Zone Gas Flow, CFH	82000	82000	84000	70000	
Air Fuel Ratio Setpoint	12	12	12	9	
Furnace Press. Setpt., in. H_2O	+.08	+.08	+.08	+.08	
Fuel Flow Integrator	985928	985962	986036	986524	
BOOS	6+8	5,7,9	4,7,10		
Load (billets per hour)					
Billet Counter					

OPERATING DATA

Location 16

Unit 1

10 inch Reheat Furnace

Test No.	16/1-18	16/1-18	16/1-18		
Date	5-6	5-6	5-6		
Time	10:00	11:05	12:06		
Soak Zone, °F	2310	2215	2215		
Top Zone, °F	2090	2080	2040		
Soak Zone Air Flow, CFH	10000	13400	18700		
Soak Zone Gas Flow, CFH	5000	7900	12700		
Air Fuel Ratio Setpoint	-5	-5	-5		
Heating Zone Air Flow, CFH	104000	104000	104000		
Heating Zone Gas Flow, CFH	81000	85000	87000		
Air Fuel Ratio Setpoint	+10	+13	+13		
Furnace Press. Setpt., in. H_2O	+.07	+.08	+.08		
Fuel Flow Integrator	993205	993621	994122		
BOOS	0	0			
Load (billets per hour)					
Billet Counter SINCE 6 AM	482	645	848		

PARTIC →

LOCATION 16

Fuel Gas Analysis

O_2	0.02% by volume
CO	0.38%
N_2	1.27
CH_4	93.36
Ethane	3.77
Propane	0.92
Iso Butane	0.08
N Butane	0.13
Pentane	0.102
Pentane +	0.102
Organic sulfur	0.2 gr/100 SCF
H_2S	0.01 grain/100 SCF
Heating Value	1049 Btu/SCF
Specific Gravity	0.5957

GASEOUS FUEL ANALYSIS

Test No _____

Test No 16/1 Date 5-16-77 Location 16 Engr BUENING

Unit No. 10" RH Fuel NG Fuel Sample No _____

Fuel Sample Point _____ Fuel Analysis by GAS COMPANY

Gas		% Volume		CF air / CF fuel	Btu(HHV) / CF fuel	CF CO_2 / CF fuel	CF H_2O / CF fuel	CF Prod / CF fuel	lb Prod / CF fuel
CH_4	Methane	93.36	x	0.0955	9.94	0.01	0.02	0.1055	0.000416
C_2H_6	Ethane	3.77	x	0.1671	17.51	0.02	0.03	0.1821	0.000786
C_3H_8	Propane	.92	x	0.2387	25.19	0.03	0.04	0.2587	0.001171
C_4H_{10}	Butane	.13	x	0.3103	33.21	0.04	0.05	0.3353	0.001548
C_5H_{12}	Pentane	.102	x	0.3819	41.11	0.05	0.06	0.4119	0.001864
C_2H_4	Ethylene		x	0.1432	15.80	0.02	0.02	0.1532	0.000726
C_3H_6	Propylene		x	0.2148	23.33	0.03	0.03	0.2298	0.001087
C_4H_8	Butylene		x	0.2869	31.23	0.04	0.04	0.3068	0.001449
C_5H_{10}	Pentylene		x	0.3580	39.16	0.05	0.05	0.3830	0.001813
C_2H_2	Acetylene		x	0.1193	14.57	0.02	0.01	0.1343	0.000682
C_6H_6	Benzene		x	0.3580	38.48	0.06	0.03	0.3730	0.002017
O_2	Oxygen	.02	x	-0.0477				-0.0377	0.000828
N_2	Nitrogen	1.27						0.01	0.000728
CO_2	Carb. Diox					0.01		0.01	0.001145
CO	Carb. Monox	.38	x	0.0239	3.15	0.01		0.0289	0.000724
H_2	Hydrogen		x	0.0239	3.18		0.01	0.0289	0.0000522
	Total	99.95				1.0507	2.03	10.882	

Theoretical Air:

$$\frac{\text{SCF air}}{10^6 \text{ Btu}} = \frac{\text{CF air}}{\text{CF fuel}} \times 10^6 \Big/ \frac{\text{Btu(HHV)}}{\text{CF fuel}} = \_\_\_\_\_$$ SCF air/10^6 Btu @ 70°F, 29.92 in. Hg.

$$\frac{\text{WSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{CF Prod}}{\text{CF fuel}} \times 10^6 \Big/ \frac{\text{Btu(HHV)}}{\text{CF fuel}} = \_\_\_\_\_$$ Wet SCF Prod/10^6 Btu

$$\% \text{ Moisture} = \frac{\text{CF } H_2O}{\text{CF fuel}} \times 100 \Big/ \frac{\text{CF Prod}}{\text{CF fuel}} = \_\_\_\_\_$$ % H_2O

$$\frac{\text{DSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{WSCF Prod}}{10^6 \text{ Btu}} \times \frac{(100 - \% \text{ Moisture})}{100} = \_\_\_\_\_$$ Dry SCF/10^6 Btu

$$\%\ CO_2, \text{ dry} = \frac{\text{CF } CO_2}{\text{CF fuel}} \times 100 \Big/ \left(\frac{\text{CF Prod}}{\text{CF fuel}} - \frac{\text{CF } H_2O}{\text{CF fuel}}\right) = 11.87$$ %CO_2, dry

$$K = \frac{331.5 \times 10^6}{MW \times (\text{DSCF}/10^6 \text{ Btu})}$$

$K' = K/430$

$lb/10^6 \text{ Btu} = (\text{ppm @ 3\% } O_2)/K$

$ng/J = (\text{ppm @ 3\% } O_2)/K'$

	MW	K for lb/10^6 Btu	K' for ng/J
NOx	46		
CO	28		
HC	16		
SOx	64		

Data Sheet 6002-6 (Rev. 1)

PARTICULATE EMISSION CALCULATIONS

Test No. 16/1-18 Date 5-6-77 Location 16 Engr. _____

Unit No. 1 Fuel NAT. GAS Sampling Train and Method EPA #5

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} 29.90 in. Hg

Tot. Liquid Collected, V_{lc} 134.5 ml Total Particulate, M_n 49.3 m gm

Velocity Head, ΔP 0.132 iwg Stack Temp., Ts 1315 °R Stack Area, As 18.3 ft^2

Sample Volume, Vm 66.44 ft^3 Stack Press., Psg -1.3 iwg Excess O_2, XO_2% 13.5 %

Orifice Press. Diff., H 0.613 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 120 min Nozzle Dia., Dn 3/8 in. Meter Temp., T_m 551 °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	66.45	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	6.375	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.0875	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	0.0114	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	1.636×10^{-6}	lb/DSCF
	c. C = Eq. 4b x 16.018×10^{3}	2.62×10^{-2}	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	405.3	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps}} \times \frac{1.00}{Gs}$	1907	ft/min
7. Stack Gas Flow Rate @ 70°F	a. Qsw = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	14004	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	12779	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	2.09×10^{-2}	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	282	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	.0404	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	17.33	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	103.3	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$(°R) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE CALCULATION SHEET

Test No. 16/1-18 Date 5-6-77 Location 16 Test Crew WC/HB/MBH
Box No. 1 Sample Probe Position 29" in/MID-POINT STACK
Test Description BASELINE

Dry Gas Meter Vol. (ft^3)
Final 3599.092
Initial 3532.655
Total 66.437

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final	198	121	3	673.4	995.4
Initial	100	100	0	660.9	860.9
Δ Vol	98	21	3	12.5	134.5

Beaker No.		5	6	7	8		Filter No. 3	Blank No. 4
Date Weighed		5-3-77	———	———	→		5-3-77	5-3-77
Tare Wt.	1	98.9196	100.4831	104.0046	99.3227		.8295	.8370
	2	—	—	—	—		—	—
	3							—
	4							—
	5							.8371
	6							—
Avg		98.9196	100.4831	104.0046	99.3227		.8295	.8370
Bottle No.		1	2	3	H_2O BLANK			
Content		Impinger (Water)	Probe (Acetone)	Probe (Water)	Cyclone (Acetone)	Flask (Dry)		
Rinse (ml)		775	550	375	100			
Date Weighed or 250 Bake		5-10-77	———	———	→		5-10-77	5-10-77
Final Wt. 250	1	98.9335	100.4930	104.0312	99.3233		.8393	.8377
	2	—	—	—	—		—	—
	3							
	4							
	5							
	6							
Avg		98.9335	100.4930	104.0312	99.3233		.8393	.8377
Residue wt Final 250-Tare		.0139	.0099	.0266	+.0006		.0098	+.0007
~~Date Weighed~~ ~~or 650 Bake~~		-.0046 .0093	-.0033 .0066	-.0023 .0243			-.0007 .0091	
Final Wt. 650	1							
	2							
	3							
	4							
	5							
	6							
Avg								
Residue Wt Final 650-Tare								

Comments: ALL WEIGHTS DONE ON LOCATION 16's BALANCE BY A LOCATION 16 EMPLOYEE. (LAB ASSISTANT)

Data Sheet 6002-3

PLANT
LOCATION 16
OPERATOR
DATE 5-6-77
RUN NO. 16/1-18
SAMPLE BOX NO. 1
METER BOX NO. 1
METER H
C FACTOR @ .83

METHOD 5 CONTROL CONSOLE READINGS

AMBIENT TEMPERATURE 65 °F
BAROMETRIC PRESSURE 29.90
ASSUMED MOISTURE, % 9
HEATER BOX SETTING 6
PROBE LENGTH, IN. 72
NOZZLE DIAMETER, IN. 3/8
PROBE HEATER SETTING 6

SCHEMATIC OF STACK CROSS SECTION

Traverse Point Number	Sampling Time ~~(e)~~ Min. CLOCK TIME	Static Pressure (P_g), In. ~~Hg~~ H_2O	Stack Temperature (T_s) °F	Velocity Head (P_s) in. H_2O	Pressure Differential Across Orifice Meter (ΔH), In. H_2O	Gas Sample Volume METER READING (V_m) ft^3	Gas Sample Temperature at Dry Gas Meter		Sample Box Temprtature °F	Temperature of Gas Leaving Condenser on Last Impinger °F
							Inlet ($T_{min.}$) °F	Outlet (T_{mout}) °F		
	1000	-1.3	812	.10	.48	3532.655		69	320	55
	1015		790	.11	.53	3541.0		72	340	50
	1030		840	.10	.48	3550.2		80	360	50
	1045		842	.10	.48	3557.4		88	360	50
	1100		860	.11	.53	3565.8		92	380	52
	1115		878	.12	.56	3573.0		98	360	55
	1130		885	.15	.70	3582.1		102	355	55
	1145		900	.2	.88	3590.8		105	350	60
	1200	↓	890	.2	.88	3599.092		110	350	57
TOTAL								AVG.	AVG.	
AVERAGE								AVG		

PLUME OPACITY OBSERVATION RECORD

Test Run No. 16/1-8

LOCATION NO. 16 OBSERVER MBH

OWNER _____ BOILER NO. _____ CAPACITY _____ klb/hr

DATE 5-6-77 FUEL TYPE _____ BURNER TYPE _____

POINT OF EMISSION STACK

POINT OF OBSERVATION SOUTHEAST OF STACK

TOO HAZY TO TAKE READINGS

TEST			Test Load	Opacity	WIND		Sky Cond.	Sun Position	Comments
No.	Time am/pm	Type	k#/hr	%	Speed mph	Direct.			

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 5-3-77 _____

Location: BASE OF STACK _____

Unit: _____ _____

Test: _____ Personnel: _____

Fuel: _____ _____

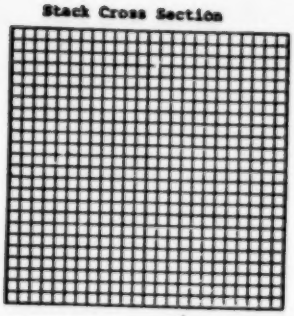
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): _____ (P_s)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2} \qquad \Delta P_s = -0.99$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O)	Gas Temp. (°F)	Gas Temp. (°R)	Molecular Wt.	Velocity (ft/sec)	O_2 Conc. (% Dry)
		in.	ΔP		T_s	M_s	V_s	
		10	.075	545				
		20	.01	540				
		30	.01	495				
		40	0	470				
		50	>0	465				
		58	>0	455				
		50	.005	455				
		40	0	450				
		30	.012	450				
		20	.017	445				
		10	.015	435				
		30	.20	700				

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 5-6-77 _____

Location: 16 _____

Unit: 1 _____

Test: 16/1-18 Personnel: _____

Fuel: _____ _____

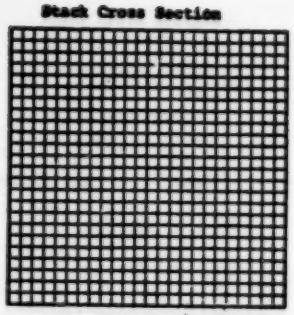
Barometric Press. (in. Hg): 29.91

Absolute Static Press. in Stack (in. Hg): _____ (P_g)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O)	Gas Temp. (°F)	Gas Temp. (°R)	Molecular Wt.	Velocity (ft/sec)	O_2 Conc. (% Dry)
		in.	ΔP		T_s	M_s	V_s	
		10	.37	820				
		20	.23	820				
		30	.1	810				
		40	.045	802				
		50	.035	800				
		56	.05	800				
		56	.065	800				
		50	.04	800				
		40	.06	820				
		30	UNIT	UPSET,				
		20	DAMPER	MOVING				
		10						

6003-13

Date 5-4-77

K V B. INC.

Test No. 16/1-6A

SOx DATA SHEET

TEST NO. 16/1-6A UNIT NO. 10 R.F. FUEL N.G. LOAD 580 84 klb/hr ____ Location ____

Box No.	*X-1	*X-1	X-2	X-2	
Time	0905	0924	0934	0953	
Temp. in Gas Meter	78°F	80°F	82°F	84°F	
Press. in Gas Meter	~~0~~	~~0~~	~~0~~	~~0~~	
Meter Reading	~~0~~	1.0	~~0~~	1.0	
Barom. Press.	30.01	30.01	30.01	30.01	
Percent Oxygen	15.8	15.8	15.8	15.8	
N_2 Purge Time	0926	0957	0958		

*H_2O Trap broke after sample/before purge

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V (P + p)}$

Excess O_2 15.8 %

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	5.7	5.2	
B = Ml of lead perchlorate used for bland =	5.0	5.0	
N = Normality of lead perchlorate titrant =	0.0105	0.0105	
F = Dilution factor =	10	1	
T = Average temp. in gas meter (°R) =	539	539	
V = Volume of gas sample ft^3 =	1.0	1.0	
P = Barometric pressure =	30.01	30.01	
p = Pressure in gas meter =	0	0	
Concentration, C, ppm =	31.6	0.9	112.5
, ym/dscm =			
Emission , E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CP\left[\frac{2090}{20.9 - xO_2}\right]$ where

C = pollutant concentration, g/dscm

P, volume factor = ____ dscm/10^4 cal

____ dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

Date_____ K V B, INC. Test No. 1W1-6B

SOx DATA SHEET

TEST NO. 1W1-6B UNIT NO. N.R.F. FUEL N.G. LOAD 510BPH klb/hr Location_____

Box No.					
Time					
Temp. in Gas Meter					
Press. in Gas Meter					
Meter Reading					
Barom. Press.					
Percent Oxygen					
N_2 Purge Time					

Calculation: SO_3 or SO_2, ppm = $\frac{(A - B) \times N \times F \times (460 + T) \times 24}{V (P + p)}$

Excess O_2 _____%

	SO_2	SO_3	SO_x
A = Ml of lead perchlorate used for sample =	5.7	5.1	
B = Ml of lead perchlorate used for bland =	5.0	5.0	
N = Normality of lead perchlorate titrant =	0.0105	0.0105	
F = Dilution factor =	10	1	
T = Average temp. in gas meter =	543	543	
V = Volume of gas sample ft^3 =	1.0	1.0	
P = Barometric pressure =	30.01		
p = Pressure in gas meter =			
Concentration, C, ppm =	31.9	0.4	112.8
, gm/dscm =			
Emission, E, g/Mcal =			
lb/MBtu =			
ng/J =			

$E = CF\left[\frac{2090}{20.9 - \%O_2}\right]$

where

C = pollutant concentration, g/dscm

F, volume factor = _____dscm/10^4 cal

_____dscf/10^4 Btu

from Fed. Reg. 9/11/74 p 32856

60-14
rev. 1/2/75

STEEL INGOT SOAKING PIT

Location No. 16 Unit No. 7

Unit Description STEEL INGOT SOAKING PIT

Installation Date

Heater Rating 2.9 MW (10 x 10⁶ Btu/hr)

Burner Description NORTH AMERICAN 6808-16

1 VARIABLE HEAT PATTERN NATURAL GAS BURNER

Test Fuel Combinations NATURAL GAS

Fuel Temp. at Burner (°F) AMBIENT

Primary Air Temp. (°F) AMBIENT

Comments:

MOBILE LABORATORY DATA Test No. _____

Test No. _____ Date 5-9-77 Location 16 Engr. WC

Unit No. _____ Fuel NAT. GAS Capacity _____

Unit Type SOAKING PIT Burner Type NO. AMERICAN 6808-16

1. Test No.	16/2-1		16/2-1		16/2-3		16/2-4			
2. Date	5-9-77		5-9-77							
3. Time	12:30		1:00		1:30		2:00P			
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft	5'x5'		→		→		→		→	
7. Probe Position	C/L		→		→		→		→	
8. Oxygen (%)	7.0		6.5		7.0		6.7		7.1	
9. NOx (hot) read/3% O_2 (ppm)	71	91	72	89	72	92	73	92	71	92
10. NO (hot) read/3% O_2 (ppm)	70	90	70	87	71	91	71	89	70	91
11. NO_2 (hot) read/3% O_2 (ppm)										
12. NO (cold) read/3% O_2 (ppm)	78	100	80	99	80	103	76	96	79	102
13. Carbon Dioxide (%)										
14. Carbon Monoxide (ppm) uncor/cor	4	5	5	6	5	6	5	6	7	9
15. Hydrocarbon (ppm) uncor/cor	60	77					230	290	60	78
16. Sulfur Dioxide (ppm) uncor/cor	0	0	0	0	0		0	0	0	0
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	60		60		60		59		59	
19. Dew Point Temp. (°F/°C)	60		60		60		59		59	
20. Atmos. Pressure (in. Hg)	29.99		30.00		30.00		30.00		30.00	
21. Relative Humidity (%) (RAIN)	100		100		100		100		100	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. _____ Date 5-10-77 Location 16 Engr. WAC

Unit No. _____ Fuel _____ Capacity _____

Unit Type SOAKING PIT Burner Type NO. AMERICAN #6808-16

	BASELINE						BASELINE			
1. Test No.	16/2-6		16/2-7		16/2-8		16/2-9		16/2-10	
2. Date	5-10-77		5-10-77		5-10-77		5-11-77		5-11-77	
3. Time	0900		0935		1000		0835		0915	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft	5'x5'		—		—		—		→	
7. Probe Position	℄		—		—		—		→	
8. Oxygen (%)	5.2		5.4		6.2		4.4		5.3	
9. NOx (hot) read/3% O_2 (ppm)	43	49	48	55	52	63	47	51	44	50
10. NO (hot) read/3% O_2 (ppm)	42	48	46	53	50	61	45	49	44	50
11. NO_2 (hot) read/3% O_2 (ppm)										
12. NO (cold) read/3% O_2 (ppm)	46	52	49	56	57	69	50	54	49	56
13. Carbon Dioxide (%)										
14. Carbon Monoxide (ppm) uncor/cor	7	8	8	9	8	10	9	10	10	11
15. Hydrocarbon (ppm) uncor/cor	5	6	5	6	5	6	20	22	20	23
16. Sulfur Dioxide (ppm) uncor/cor	0	0	0	0	0	0	0	0	0	0
17. Smoke Spot (Bacharach)	—		—							
18. Atmos. Temp. (°F/°C)	65		66		66		62		62	
19. Dew Point Temp. (°F/°C)	59		60		60		57		57	
20. Atmos. Pressure (in. Hg)	30.10		30.10		30.10		30.02		30.02	
21. Relative Humidity (%)	70		71		71		74			
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30										

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No._____ Date 5-11-77 Location 16 Engr._____

Unit No._____ Fuel NG Capacity_____

Unit Type SOAKING PIT Burner Type NO. AMER. 6808-16

1. Test No.	16/2-11		16/2-12		16/2-13		16/2-14		16/2-15	
2. Date	5-11-77		5-11-77		5-11-77		5-11-77		5-11-77	
3. Time	0935		1020		1100		1115		1125	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft	5X5		—		—		—		—	
7. Probe Position	℄		⋯		⋯		⋯		⋯	
8. Oxygen (%)	3.8		2.7		3.6		3.9		4.0	
9. NOx (hot) read/3% O_2 (ppm)	38	40	29	28	49	51	50	53	54	57
10. NO (hot) read/3% O_2 (ppm)	37	39	28	28	48	50	48	50	53	56
11. NO_2 (hot) read/3% O_2 (ppm)										
12. NO (cold) read/3% O_2 (ppm)	44	46	33	32	52	54	56	59	60	64
13. Carbon Dioxide (%)										
14. Carbon Monoxide (ppm) uncor/cor	12	12	16	16	12	12	12	13	6	6
15. Hydrocarbon (ppm) uncor/cor	30	31	30	30	20	21	20	21	20	21
16. Sulfur Dioxide (ppm) uncor/cor	0		0	0	0	0	0	0	0	0
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	64		64						64	
19. Dew Point Temp. (°F/°C)	57		57						57	
20. Atmos. Pressure (in. Hg)	30.02		29.99						29.94	
21. Relative Humidity (%)	66		66						66	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

SHORTENED FLAME

SHORTENED FLAME

LOWER O_2 MIN O_2 BASELINE

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No._____ Date 5-11-77 Location 16 Engr. WAC

Unit No._____ Fuel N. G Capacity_____

Unit Type SOAKING PIT Burner Type NO. AMER 6808-16

1. Test No.	16/2-16		16/2-17									
2. Date	5-11-77		5-11-77									
3. Time	1145		1215									
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position												
8. Oxygen (%)	4.9		5.0									
9. NOx (hot) read/3% O_2 (ppm)	45	50	49	55								
10. NO (hot) read/3% O_2 (ppm)	44	49	48	54								
11. NO_2 (hot) read/3% O_2 (ppm)												
12. NO (cold) read/3% O_2 (ppm)	50	56	54	61								
13. Carbon Dioxide (%)												
14. Carbon Monoxide (ppm) uncor/cor	4	4	8	9								
15. Hydrocarbon (ppm) uncor/cor	<10	11	10	11								
16. Sulfur Dioxide (ppm) uncor/cor	0	0	0	0								
17. Smoke Spot (Bacharach)												
18. Atmos. Temp. (°F/°C)			68									
19. Dew Point Temp. (°F/°C)			60									
20. Atmos. Pressure (in. Hg)			29.99									
21. Relative Humidity (%)			64									
22.												
23.	LENGTHENED FLAME		NORMAL BURNER/FLAME SETTING									
24.												
25.												
26.												
27.												
28.												
29.												
30.												

BASELINE

OPERATING DATA

Location 16

Unit 2

Soaking Pit

Test No.	16/2-1	16/2-2	16/2-3	16/2-4	16/2-5
Date	5-9	5-9	5-9	5-9	5-9
Time	12:30	13:00	13:30	14:00	14:30
Pit Temp., °F	2390	2375	2370	2365	2362
North Pit Temp., °F	2390	2375	2370	2365	2362
Burner Position Control	44	44	44	44	44
Pit Pressure, in. H_2O	+.112	+.09	+.099	+.105	+.094
Battery Gas Press., psig	6.5	6.5	6.5	6.5	6.5
Flue Press., in. H_2O	-.064	-.062	-.064	-.063	-.064
Gas Flow Indic., CFH x 300	25.5	29.5	31	22.5	21
Air Flow Indic., CFH x 3000	28.0	20.5	22.5	25	24
Fuel/Air Ratio Control	24.5	19.5	21.5	15.5 / 20.5	15 / 20.5
Total Gas Flow Indic. (Two Pits)	564576	564686	564805	564925	565037

Comments: BASE →

OPERATING DATA

Location 16

Unit 2

Soaking Pit

Test No.	16/2-6	16/2-7	16/2-8	16/2-9	16/2-10
Date	5-10	5-10	5-10	5-11	5-11
Time	9:00	9:35	9:53	8:35	9:15
Pit Temp., °F	2396	2400	2390	2400	2400
North Pit Temp., °F	2396	2400	2390	2400	2400
Burner Position Control	43.5	43.5	43.5	44	44
Pit Pressure, in. H_2O	+.125	+.115	+.124	+.09	+.115
Battery Gas Press., psig	6.6	6.6	6.6	6.6	6.6
Flue Press., in. H_2O	-.064	-.065	-.063	-.064	-.034
Gas Flow Indic., CFH x 300	30	29	27	22.5	21.5
Air Flow Indic., CFH x 3000	32	31	31.5	26	26
Fuel/Air Ratio Control	24 | 28.5	22.5 | 28	22 | 29	22 | 17	16 | 23
Total Gas Flow Indic. (Two Pits)	571373	571574	571664	579660	579837
Comments:	BASE	BASE	HI O_2	BASE	HI O_2

OPERATING DATA

Location 16

Unit 2

Soaking Pit

Test No.	16/2-11	16/2-12	16/2-13	16/2-14	16/2-15
Date	5-11	5-11	5-11	5-11	5-11
Time	9:35	10:20	11:03	11:16	11:30
Pit Temp., °F	2401	2400	2400	2400	2400
North Pit Temp., °F	2401	2400	2400	2400	2400
Burner Position Control	44	44	44	59	75
Pit Pressure, in. H_2O	+.098	+.084	+.09	+.09	+.09
Battery Gas Press., psig	6.6	6.6	6.6	6.6	6.6
Flue Press., in. H_2O	-.065	-.064	-.064	-.065	-.065
Gas Flow Indic., CFH x 300	20.5	17	21	21	21
Air Flow Indic., CFH x 3000	20.5	15	22	22	22
Fuel/Air Ratio Control	14 | 17	11.5 | 11.5	15 | 18	14.5 | 18	14.5 | 18
Total Gas Flow Indic. (Two Pits)	579436	580108	580272	580321	580373
Comments:	LOW O_2	LOW O_2	BASE	BURNER POSIT. SHORT →	

OPERATING DATA

Location 16

Unit 2

Soaking Pit

Test No.	16/2-16	16/2-17			
Date	5-11	5-11			
Time	11:45	12:15			
Pit Temp., °F	2400	2400			
North Pit Temp., °F	2400	2400			
Burner Position Control	34	44			
Pit Pressure, in. H_2O	+.09	+.09			
Battery Gas Press., psig	6.6	6.6			
Flue Press., in. H_2O	-.065	-.065			
Gas Flow Indic., CFH x 300	21	20.5			
Air Flow Indic., CFH x 3000	22	21.5			
Fuel/Air Ratio Control	15.5 | 19.5	14 | 18			
Total Gas Flow Indic. (Two Pits)	580427	580527			
Comments:	LONGER FLAME	BASE			